Specialty Surgical Hospital

6330 Mourning Dove Drive
Baton Rouge, Louisiana 70816

CD Pricing Specifications – Volume 1

Date: June 29, 2023
GHC Project #: 6022158

Specialty Surgical Hospital

6330 Mourning Dove Drive
Baton Rouge, Louisiana 70816

CD Pricing Specifications – Volume 2

Date: June 29, 2023
GHC Project #: 6022158

00 00 02 – PROJECT DIRECTORY

Owner:

Stumberg Medical, LLC
P.O. Box 80063
Baton Rouge, LA. 70898

Architect/Interior Design:

Grace Hebert Curtis Architects, LLC
501 Government St., Suite 200
Baton Rouge, LA 70802
p. 225.338.5569

Structural Engineer

Fox-Nesbit Engineering
9100 Bluebonnet Centre Blvd., Suite 301
Baton Rouge, LA 70809
p. 225.293.6595

Mechanical Engineer

M&E Consulting
1304 Bertrand Drive, Suite F7
Lafayette, LA 70506
p. 337.234.7474

Electrical Engineer

M&E Consulting
1304 Bertrand Drive, Suite F7
Lafayette, LA 70506
p. 337.234.7474

Civil Engineer

Bonton Associates
232 Third Street
Baton Rouge, LA 70801
p. 225.706.0975

Landscape Architect

Musso's Landscape Design
18470 Blythe Road
Prairieville, LA 70769
p. 225.910.3691

SECTION 00 0003 – PROFESSIONAL SEALS

ARCHITECT – GRACE HEBERT CURTIS ARCHITECTS, LLC	STRUCTURAL ENGINEER	CIVIL ENGINEER
ELECTRICAL ENGINEER	MECHANICAL & PLUMBING ENGINEER	LANDSCAPE ARCHITECT

SECTION 00 0005 – INSTRUCTIONS TO BIDDERS

1.01 BIDDING DOCUMENTS

A. The Bidding Documents include the following:
   1. Instructions to Bidders
   2. General Conditions of the Contract for Construction
   3. Bid Form
   4. Bid Bond
   5. Special Conditions
   6. Contract Between Owner and Contractor - AIA Document A101, available from Architect upon request.
   7. Performance Bond - Refer to specification section Special Conditions
   8. Payment Bond - Refer to specification section Special Conditions
   9. Specifications & Drawings
   10. Addenda issued during the bid period and acknowledged by the Bidder

B. All definitions set forth in the General Conditions of the Contract for Construction, or in other Contract Documents are applicable to the Bidding Documents.

C. Addenda are written and/or graphic instruments issued by the Architect prior to the opening of bids which modify or interpret the Bidding Documents by additions, deletions, clarifications, corrections and prior approvals.

D. A bid is a complete and properly signed proposal to do the work or designated portion thereof for the sums stipulated therein supported by data called for by the Bidding Documents.

E. Base bid is the sum stated in the bid for which the Bidder offers to perform the work described as the base, to which work may be added, or deleted for sums stated in alternate bids.

F. An alternate bid (or alternate) is an amount stated in the bid to be added (if an Additive Alternate), or deducted (if an Deductive Alternate) to the amount of the base bid if the corresponding change in project scope or materials or methods of construction described in the Bidding Documents is accepted.

G. A Bidder is one who submits a bid for a prime Contract with the Owner for the work described in the proposed Contract Documents.

H. A Sub-bidder is one who submits a bid to a Bidder for materials and/or labor for a portion of the work.

I. Where the word "Architect" is used in any of the documents, it shall refer to the Prime Designer of the project, regardless of discipline.

1.02 ACCESS TO BIDDING DOCUMENTS

A. Complete bidding documents can be obtained at www.centerlinebidconnect.com via the Centerline Bidding module. A secure password is required to access documents for Private Bids only. This password is emailed to all invited subscribers when the bid process becomes **live**. Publicly Bid projects do not require a password.

B. If electronic distribution is available, printed copies will not be available from the Designer, but arrangements can be made to obtain them through most reprographic firms and/or plan rooms.

C. All plan holders are responsible for their own reproduction costs. No reproduction costs will be refunded.

D. Complete sets of Bidding Documents shall be used in preparing bids; neither the Owner nor the Architect assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

E. The Owner or Architect in making copies of the Bidding Documents available on the above terms, do so only for the purpose of obtaining bids on the work and do not confer a license or grant for any other use.

1.03 INTERPERTATION OF THE BIDDING DOCUMENTS

A. Bidders shall promptly notify the Architect through Centerline of any discrepancy, ambiguity, inconsistency or error which they may discover upon examination of the Bidding Documents or of the site and local conditions. Failure to notify the Architect thru Centerline of any discrepancy, ambiguity, inconsistency, or error upon discovery of the item shall cause the bidder to be bound by the interpretation of the Architect in regards to the discrepancy, ambiguity, inconsistency or error.

B. Prospective bidders desiring further information or interpretations of the Drawings and/or Specifications must request such data from the Architect electronically via Centerline. Answers to all questions, inquiries and requests for additional information will be issued in the form of Addenda to the Drawings and Specifications and copies of each addendum will be posted on Centerline to all prospective bidders. Every request for such interpretation should be submitted electronically via Centerline. To be given consideration, requests must be RECEIVED at least seven (7) days prior to date fixed for the opening of bids. Any and all such interpretations and any supplemental instructions will be in the form of written addenda to the Specifications and/or Drawings.

C. Refer to Specification Section 00 0005a How to enter Request for Information (RFI) and Prior Approvals from bidding side.

D. Any interpretation, correction or change of the Bidding Documents will be made by addendum. Interpretations, corrections or changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections and changes.

1.04 SUBSTITUTIONS

A. The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. No substitutions shall be allowed after bidding.

B. Where a single manufacturer or trade name appears in these Specifications, and / or the words "or equal" follow, it is the intent of these specifications that products of equal quality which meet the Architect's approval may be used. The brand, make or manufacturer listed describes the general style, type, character and quality of product desired.

C. Requests for approval of substitute materials of equal quality and performance to those specified shall be RECEIVED by the Architect electronically via Centerline no later than seven (7) days before the date set for the opening of bids.

D. No substitution will be considered unless written request for approval has been submitted by the Bidder and has been received by the Architect at least seven (7) working days prior to the date for receipt of bids. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including model numbers, drawings, cuts, performance and test data and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or work that incorporation of the substitute would require shall be included. It shall be the responsibility of the proposer to include in his proposal all changes required of the Contract Documents if the proposed product is used. Prior approval is given contingent upon supplier being responsible for any costs which may be necessary to modify the space or facilities needed to accommodate the materials and equipment approved.

E. If the Architect approves any proposed substitution, such approval will be set forth in an addendum. Bidders shall not rely upon approvals made in any other manner.

1.05 ADDENDA

A. Addenda will be posted electronically on Centerline. All bidders registered on Centerline and attached to the project shall receive notice of each addendum and will be able to view, download or send it to printer.

B. Additional copies of addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

C. Each Bidder shall ascertain from the Architect prior to submitting his bid that he has received all addenda issued, and he shall acknowledge their receipt on the Bid Form.

1.06 BID SUBMISSION

A. Deliver written bids to the address indicated on the Invitation for Bids, prior to the time and date for submission indicated on the Invitation for Bids. Any bid received after the time and date indicated shall be disqualified. The bid form and all documents required to accompany the bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the bids, and shall be identified by the Project Name, the Bidder's name, address the Bidders state contractor's license number, and the notation "SEALED BID ENCLOSED".

B. Electronic Bidding: Bidders may use Centerline to submit their bids electronically. Please find bid related information and submit your electronic bids online at www.centerlinebidconnect.com. Prior to time and date indicated in the Advertisement for Bids.

C. All blanks on the Bid Form shall be filled in by typewriter or manually in ink.

D. Bid sums shall be expressed in both words and figures, and in case of discrepancy between the two, the written words shall govern.

E. Any interlineation, alteration or erasure must be initialed by the signer of the bid or his authorized representative.

F. Bidders are cautioned to complete all alternates should such be required in the Bid Form. Failure to submit alternate prices will render the proposal informal and shall cause its rejection.

G. Bidder shall make no additional stipulations on the Bid Form nor qualify his bid in any other manner.

H. The bid shall include the legal name of Bidder and shall be signed by the person or persons legally authorized to bind the Bidder to a Contract.

I. The authority of the signature of the person submitting the bid shall be deemed sufficient and acceptable under any of the following conditions:

1. Signature on bid is that of authorized representative of corporation, partnership, or other legal entity and bid is accompanied by corporate resolution, certification as to the corporate principal, or other documents, (written evidence), indicating authority.

J. On any bid in excess of fifty thousand dollars ($50,000.00), the Contractor shall be licensed under R.S. 37: 2150-2173 and show his license number on the bid above his signature or his duly authorized representative. Placement of the signature on the bid shall serve as certification of licensure.

K Bidders shall include a list of sub-contractors and vendors with their bid submission for the Owner's information.

1.07 LAWS AND REGULATIONS:

A. All laws, ordinances, and rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the Contract throughout and they shall be deemed to be included in the Contract the same as though herein written out in full.

1.08 BIDDER'S REPRESENTATION:

A. Each Bidder by making his bid represents that:

1. He has read and understands the Bidding Documents and his bid is made in accordance therewith.
2. He has visited the site and has familiarized himself with the local conditions under which the work is to be performed. No compensation shall be allowed for items of cost due to the contractor's lack of knowledge of existing conditions resulting in additional cost not included in the bid.

3. Should conditions be encountered below the natural grade which are not normally encountered and which could not be anticipated from visiting the site or from information available in the contract documents, the contractor may negotiate for additional cost as stipulated in the General Conditions of these Specifications.
4. His bid is based solely upon the materials, systems and equipment described in the Bidding Documents and as modified by addenda, and shall cover all applicable regulatory fees, building permit fees, tap fees, etc., all fees not specifically noted in the contract documents as by Owner.
5. His bid is not based on any verbal instructions contrary to the Contract Documents and addenda.
6. The Bidder must be fully qualified under any State or local licensing law for Contractors in effect at the time and at the location of the work before submitting his bid. In the State of Louisiana, Revised Statutes 37:2150, et seq. will be considered, if applicable.
7. The Contractor shall be responsible for determining that all of his Sub-bidders or prospective Subcontractors are duly licensed in accordance with law.

1.09 DURATION OF BIDS:

A. Bids shall remain open to acceptance for a period of Thirty (30) days after the bid closing date.

1.10 CONSIDERATION OF BIDS:

A. The bids received on time will be opened publicly, and a tabulation abstract of the amounts of the base bids and alternates, if any, will be made available to Bidders.

1.11 COMPLETION OF WORK AND LIQUIDATED DAMAGES:

A. If this bid is accepted, the Bidder hereby agrees to commence the work under this contract on a date specified in a written "Notice to Proceed", by the Owner and to fully complete the project no later than the **TBD (TBD) calendar days**, including Saturdays, Sundays, and holidays, after the written Notice to Proceed.

B. The Bidder hereby agrees to that the Owner may retain the sum of **TBD Dollars, ($TBD.00)**, from the amount of compensation to be paid the Bidder for each consecutive calendar day, (Saturdays, Sundays, and holidays included), after the Contract Time that the work remains incomplete beyond the completion date. This amount is agreed upon as the proper measure of liquidated damages the Owner will sustain per day by the failure of the Bidder to complete the work at the stipulated Contract time, and is not construed in any sense as a penalty.

C. The Bidder herby agrees to complete all Punch List items within **Thirty, (30),** consecutive calendar days after Substantial Completion of each Phase. The Bidder agrees to that the Owner may retain the sum of **TBD Dollars ($TBD.00),** from the amount of compensation to be paid to the Bidder for each consecutive calendar day, (Saturdays, Sundays, and holidays included), after the Punch List period (Thirty consecutive calendar days after Substantial Completion), that the work remains incomplete. This amount is agreed upon as the proper measure of liquidated damages the Owner will sustain per day by the failure of the Bidder to complete the Punch List work, and is not construed in any sense as a penalty.

1.12 ACCEPTANCE OF OFFER

A. Owner reserves the right to accept or reject any or all offers.

1.13 POST-BID INFORMATION

A. Submissions

B. Prior to the submittal of the first Application for Payment, the Contractor shall submit the following information to the Architect.
1. A designation of the work to be performed by the Contractor with his own forces.
2. A breakdown of the Contract cost attributable to each item listed in the Schedule of Values Form (attached). No payments will be made to the Contractor until this is received.
3. The proprietary names and the suppliers of principal items or systems of material and equipment proposed for the work.

4. A list of names and business domiciles of all Subcontractors, manufacturers, suppliers or other persons or organizations (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the work. It is the preference of the Owner that, to the greatest extent possible or practical, the Contractor utilize Louisiana Subcontractors, manufacturers, suppliers and labor.

C. The Contractor will be required to establish to the satisfaction of the Architect the reliability and responsibility of the proposed Subcontractors to furnish and perform the work described in the sections of the Specifications pertaining to such proposed Subcontractor's respective trades. The General Contractor shall be responsible for actions or inaction's of Subcontractors and/or material suppliers.

D. The General Contractor is totally responsible for any lost time or extra expense incurred due to a Subcontractor's/or Material Supplier's failure to perform. Failure to perform includes, but is not limited to, a Subcontractor's financial failure, abandonment of the project, failure to make prompt delivery, or failure to do work up to standard. Under no circumstances shall the Owner mitigate the General Contractor's losses or reimburse the General Contractor for losses caused by these events.

E. Subcontractors and other persons and organizations selected by the Bidder must be used on the work for which they were proposed and shall not be changed except with the written approval of the Owner and the Architect.

1.14 CONTRACT, NOTICE OF AWARD

A. Bond Requirements: Refer to Specification Section 00 0009, Supplementary Conditions

B. The Architect shall issue a Notice of Award, (signed by the Owner), to the Contractor with three original Owner / Contractor contracts, to allow the acquisition insurance certificates by the Contractor. The Contractor shall have 15 calendar day to deliver the signed contract, and Insurance Certificates to the Architect.

C. The Bidder shall require the Attorney-in-Fact who executes the required bond on behalf of the surety to affix thereto a certified and current copy of his power of Attorney.

1.15 INSURANCE REQUIREMENTS:

A. Refer to Specification Section 00 0009 Special Conditions

1.16 RELATED DOCUMENTS

A. Document 00 0006 - Bid Form

B. Document 00 0008 - General Conditions of the Contract for Construction

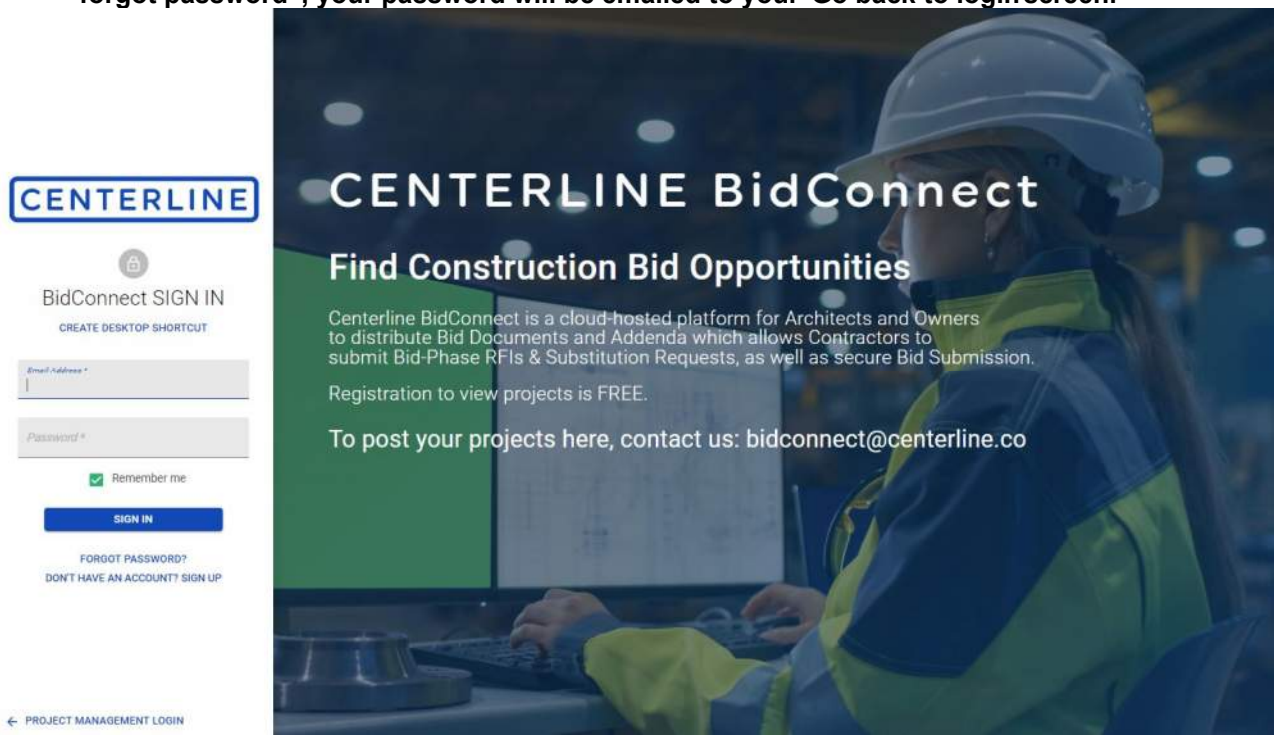
END OF SECTION

SECTION 00 0005a - HOW TO ACCESS BIDDING DOCUMENTS - PLAN HOLDER'S LIST

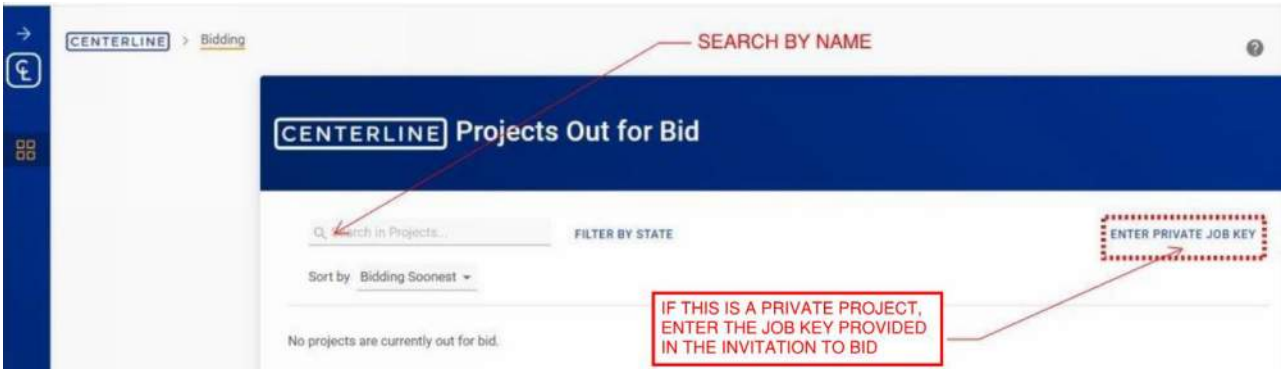
1. Go to the following site:
   www.centerlinebidconnect.com

If this is your first time to Centerline's bidding module, you will need to go to "Don't have an account? Sign Up" and fill out the form and your password will be emailed to you, then continue with instructions. Sign up if you are a first time user.

2. **Type in your username (complete email address) and password. (if you forgot it, press "forgot password", your password will be emailed to you. Go back to login screen.**



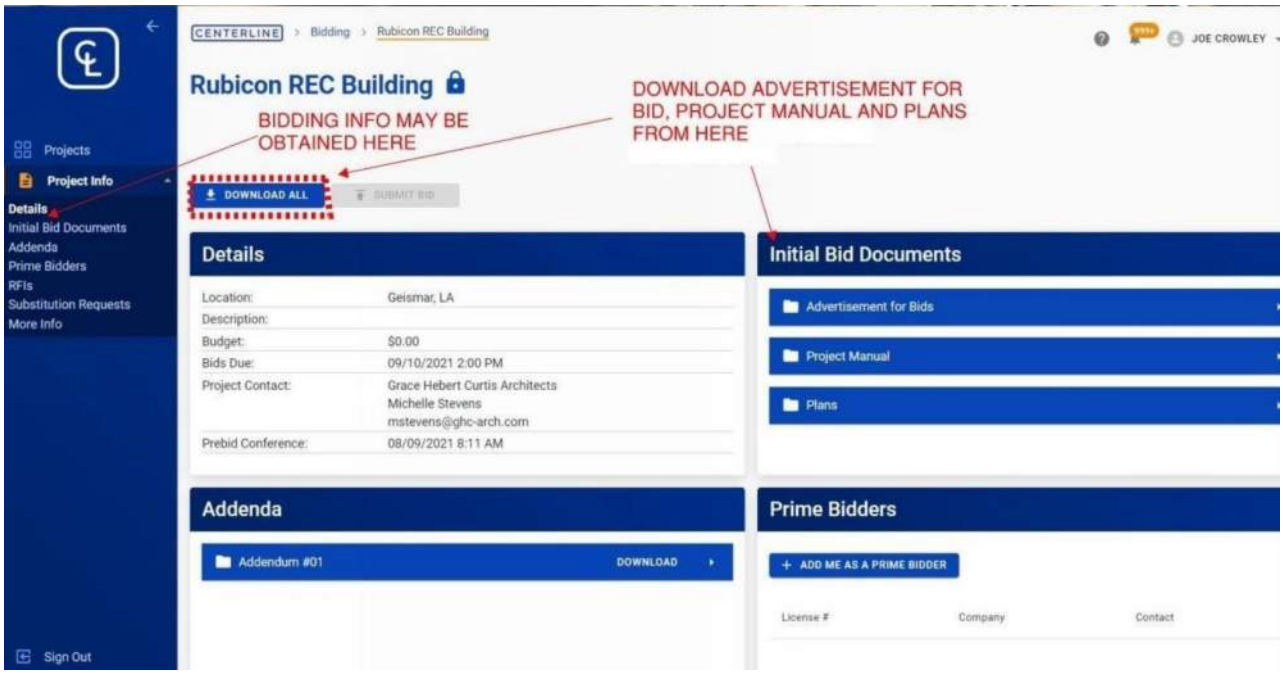
3. **The first time you log in, you will be asked to change your password.**
4. **You will be taken to a page that looks like the screenshot on the next page that reads "Projects Out for Bid".**
5. **Once in scroll until you will see the project name that you are looking for.**
6. **Click on the project.**
7. **The BID MODULE IS ON THE LOWER LEFTHAND SIDE OF THE SCREEN.**



8. **Select Project Info and a drop down menu is seen to the left.**

9. **You may download all Bid Documents, add yourself as a prime bidder and submit a bid on this page. Addenda, Prime Bidders, RFIs, Substitution Requests and More Info are placed here.**

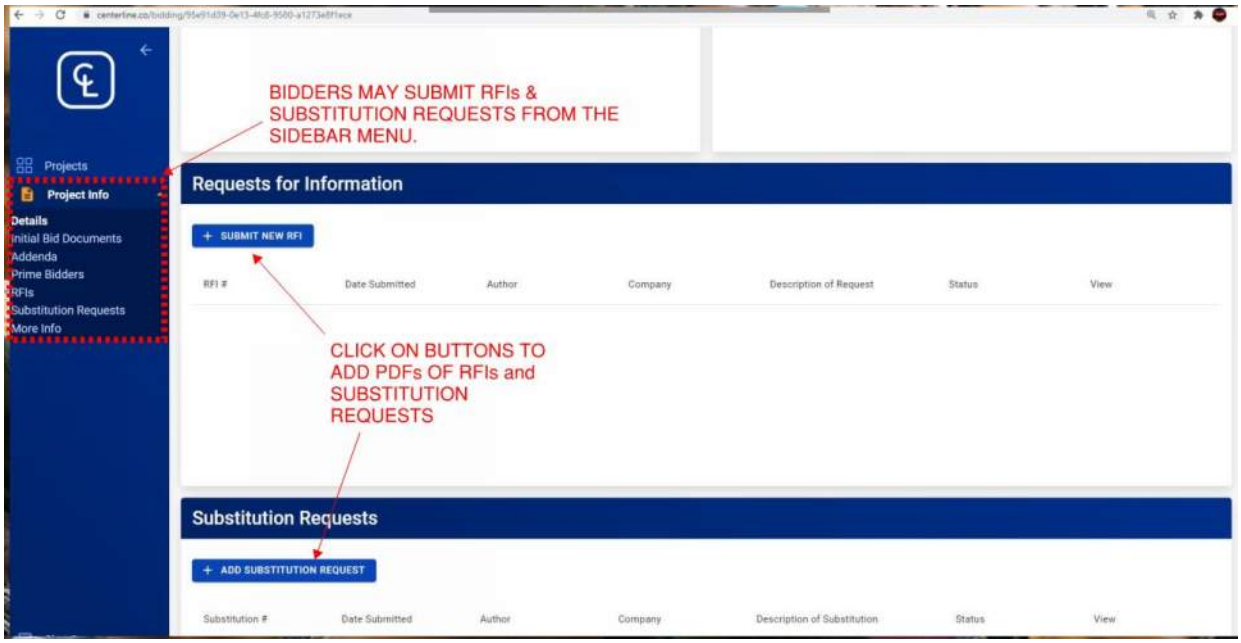
10. **Print and download any info from this page.**



END OF SECTION

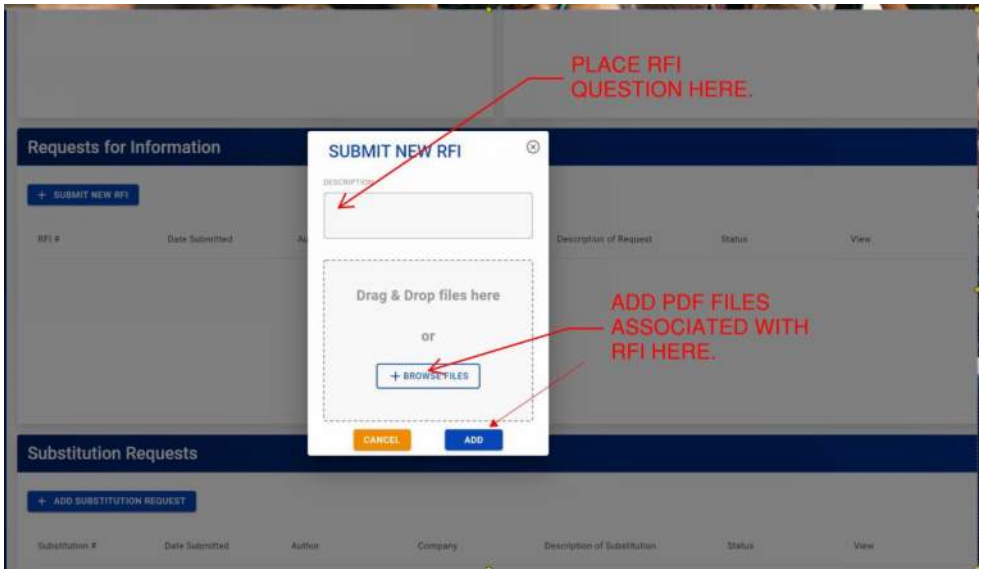
00 0005b - HOW TO ENTER REQUEST FOR INFORMATION (RFI) AND SUBSTITUTION REQUESTS FROM BIDDING SIDE

Once the bid is set up, and the User chooses the project and enters the password if a private bid, they will see the Submit buttons for NEW RFI's and SUBSTITUTION REQUESTS.

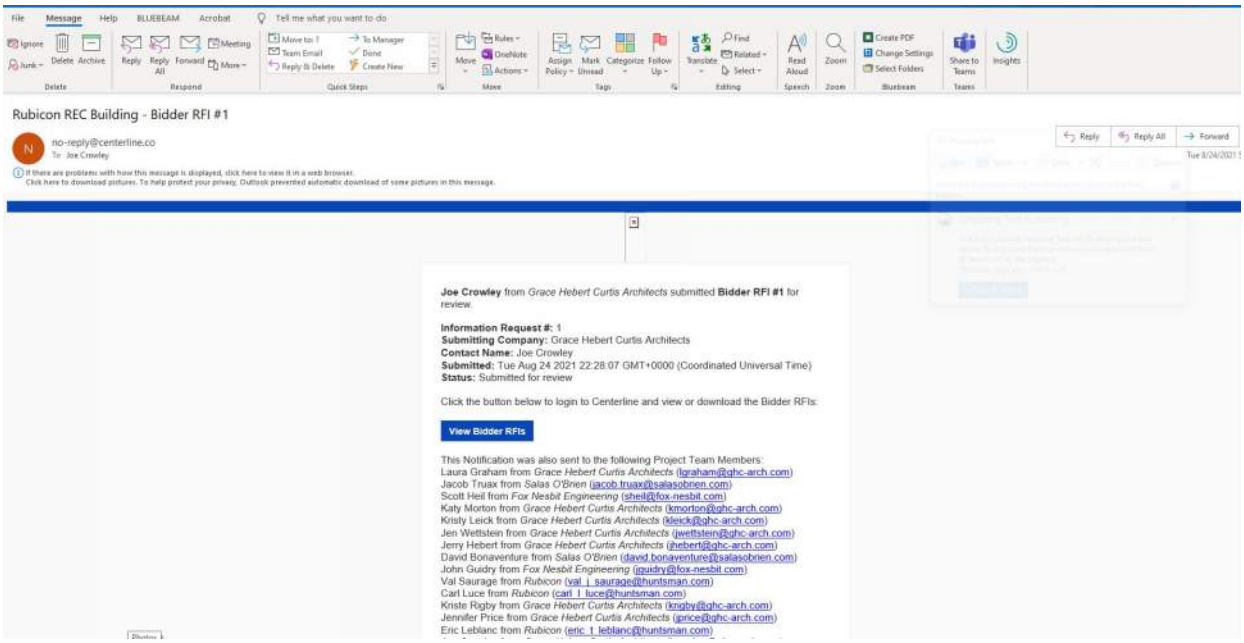


RFI

This is the SUBMIT NEW RFI form the contractor/sub-contractor will get. **Simply fill in the information and attach files and press SUBMIT RFI. Your RFI will then appear in the log below.**

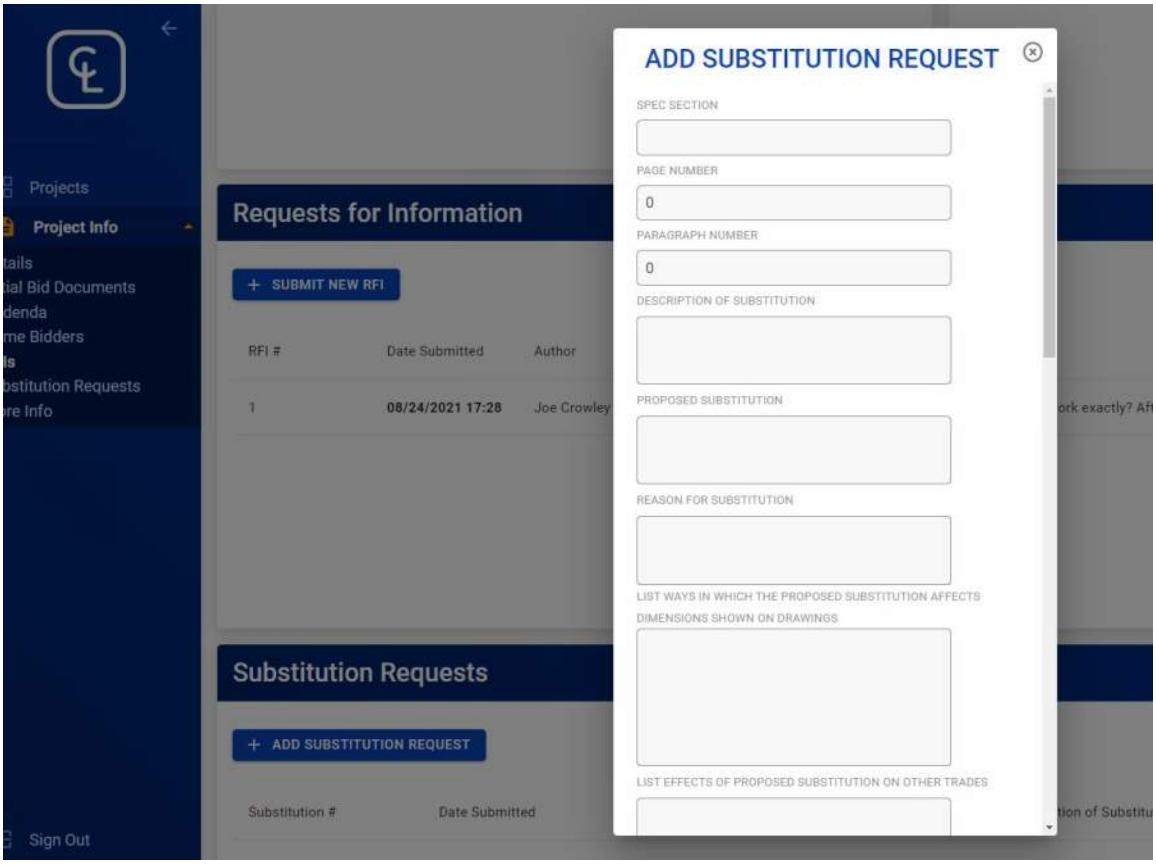


Once it is submitted, the User will receive an email to the person submitting it that it has been received. The Architect will receive a notification they have received an RFI for his project. You can click on the blue button in the email to take you to the RFI.



SUBSTITUTION REQUEST

This is what the Substitution Request looks like.
Simply fill in the information, attach necessary files and press SUBMIT SUBSTITUTION REQUEST.

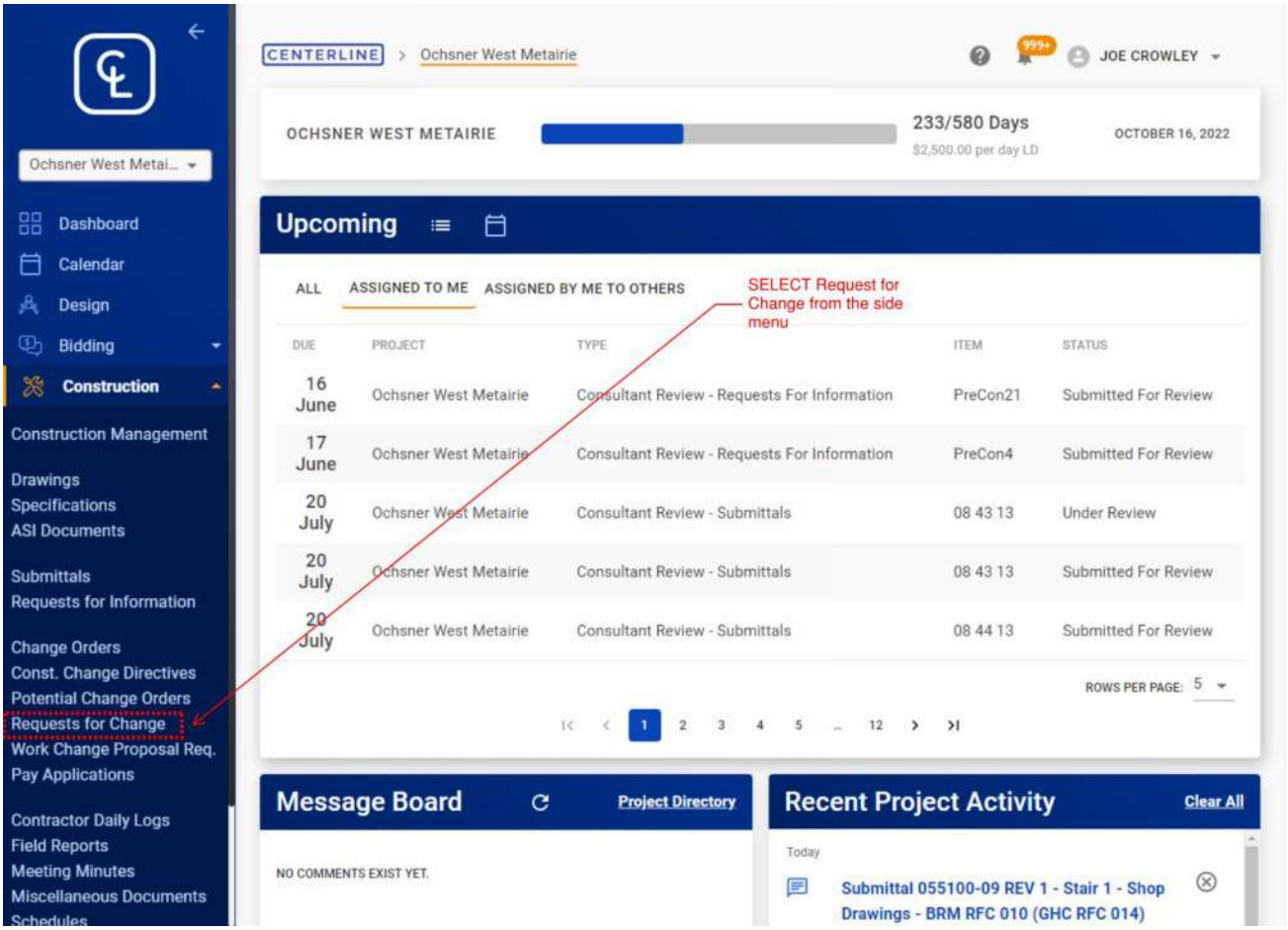


When you see the Substitution Request appear on the list where you submitted it, your Substitution Request has been submitted; you may VIEW the document and save or print as well from this location by clicking on the VIEW eyeball icon.

Once it is submitted, similar to RFIs, the User will receive an email noting that it has been received and the Architect will receive a notification that there is a Substitution Request for the project.

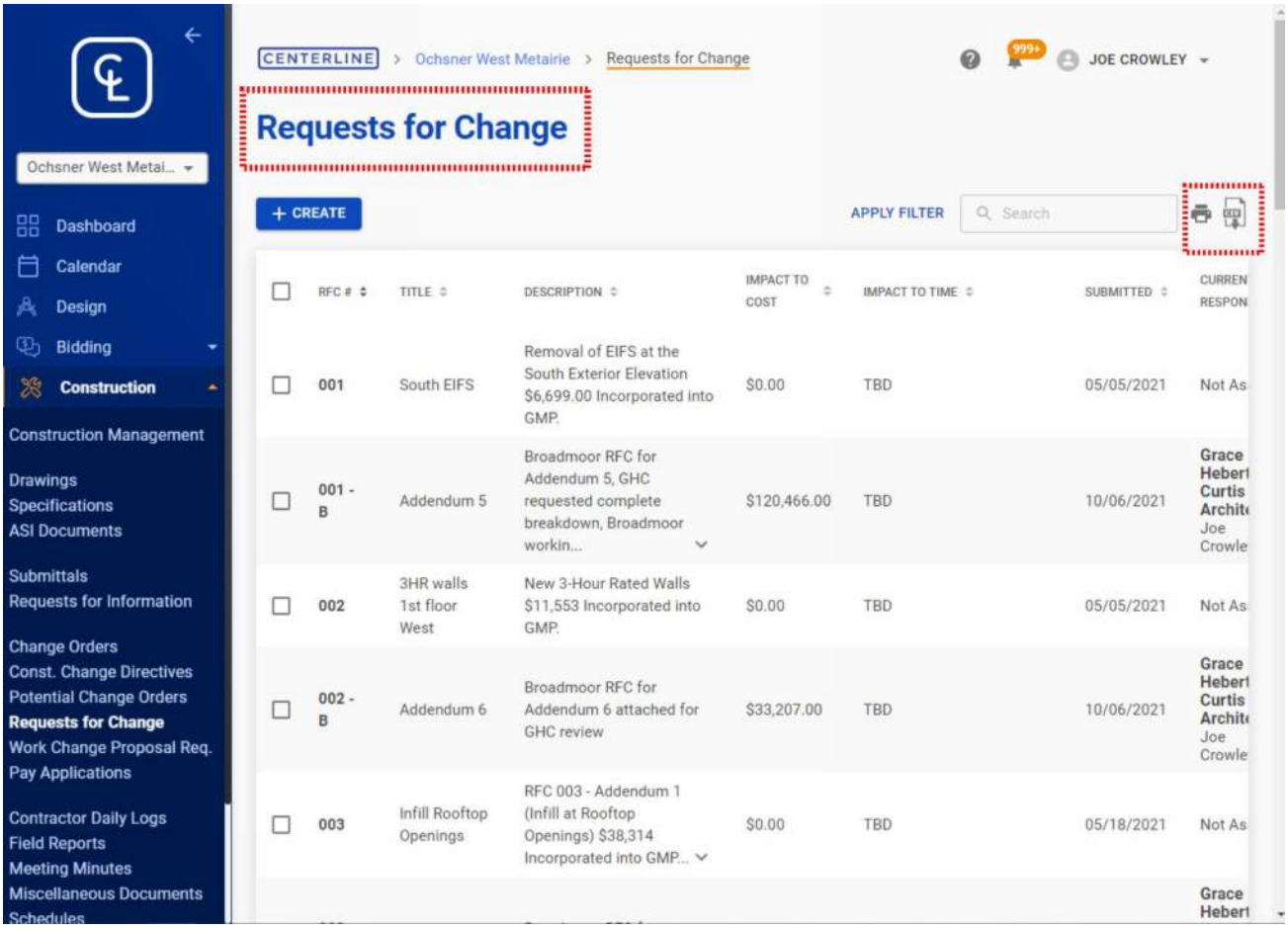
00 0005c – HOW TO ENTER REQUEST FOR CHANGE DURING CONSTRUCTION

Once the construction tab is open, and the User chooses the project and may select Request for Change to view documents that the Contractor is to price:



RFCs

The list of RFCs are displayed with the RFC #, brief description, potential impact to cost, impact to time, date submitted and current responsible party shown as seen below:



To print or save a copy of the RFC Log in PDF or Excel, click on the red rectangle in the upper right seen above.

Scroll down to view **SUPPORTING DOCUMENTS** which are organized by:

Current File and Previous Files.

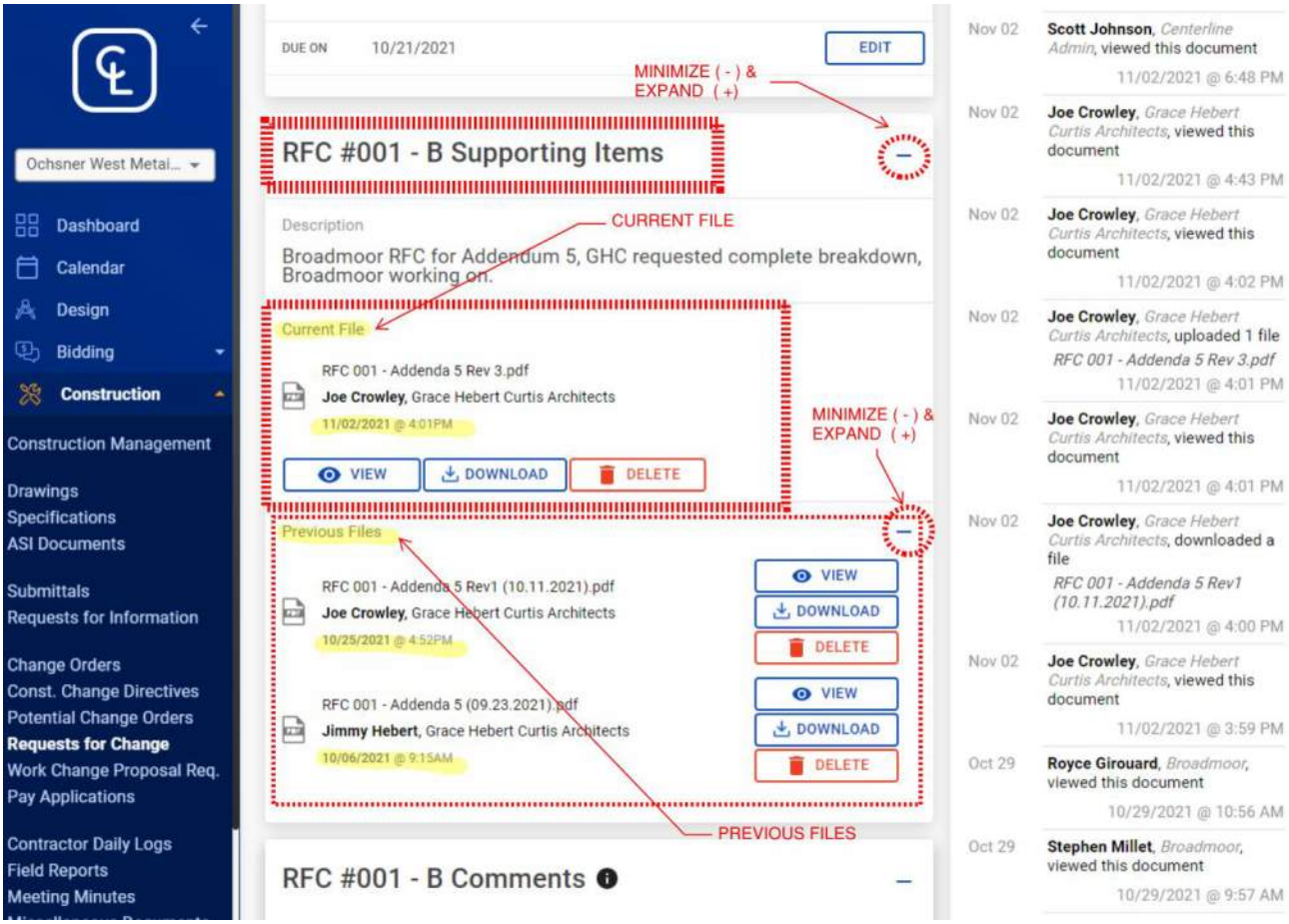
The Architect will place the Current File to be reviewed and responded to by the Contractor under the Current File tab highlighted below.

Only the files necessary to price the RFC will be located here. Previous files will be considered superseded by the Current File. Previous files may include a version of the Contractor's proposal with backup. Each file is date and time stamped to be able to easily track history of each document version.

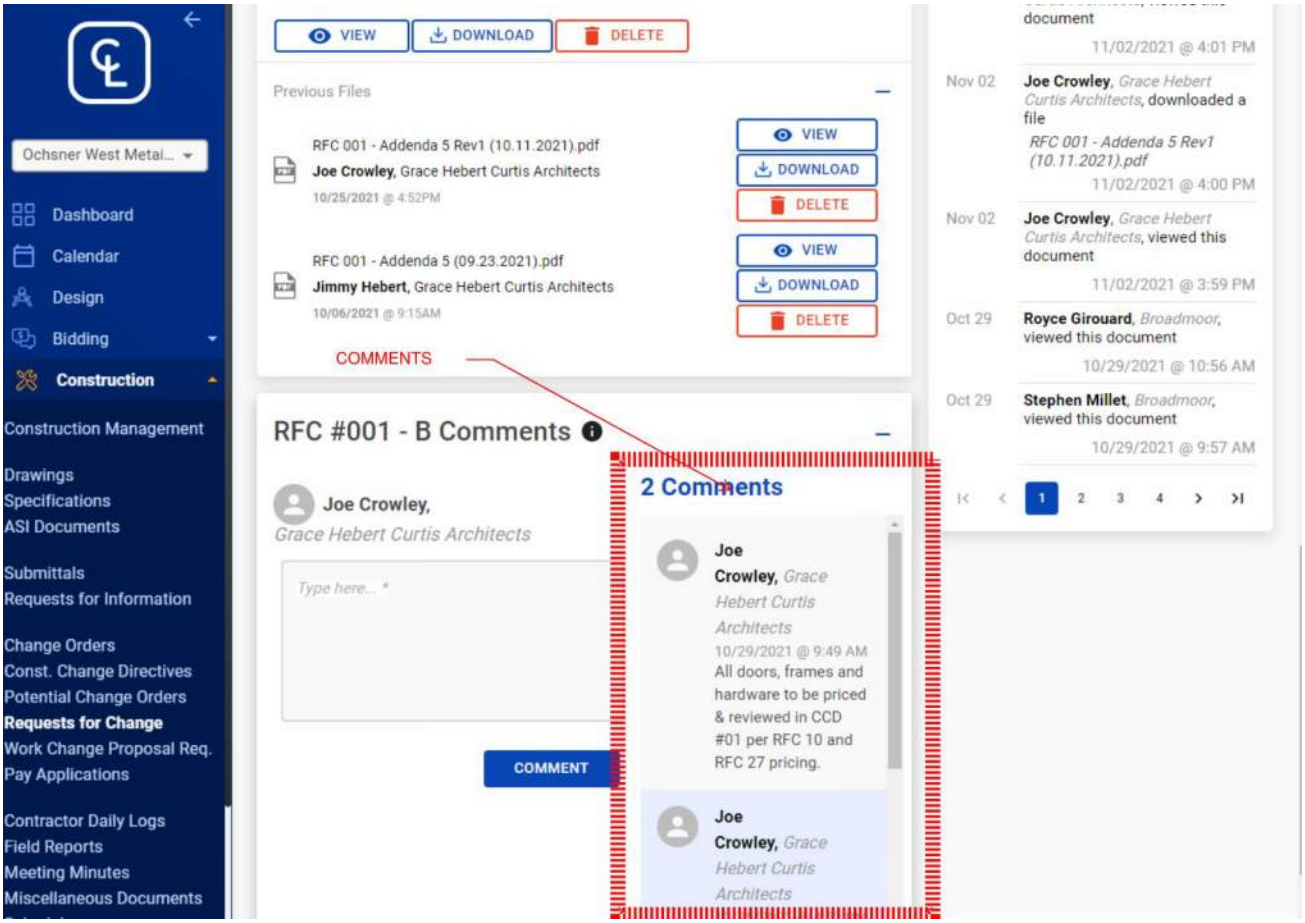
Minimize to not view all previous files if printing a summary page or expand to view previous version of files. See red circled area in the screenshot below.

Important Note to Architect, Contractor, et al:
Current file must be a **single file**.

If posting multiple files, i.e.: drawings, specifications, sketches, narratives, cutsheets and similar, Zip the files together and post the Zip folder. If files are similar in size format, i.e.: ALL full size drawings, they may be included in a single file PDF as well and posted.



Comments relevant to the RFC are below the Previous Files and are date and time stamped. Anybody in the distribution group may add comments here. While they are not part of the current file, they may modify the Request for Change and need to be reviewed. Status updates and similar comments may also be added here.



AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

6022158 Specialty Surgical Hospital

THE OWNER:
(Name, legal status and address)

Stumberg Medical, LLC
P.O. Box 80063
Baton Rouge, LA 70898

THE ARCHITECT:
(Name, legal status and address)

Grace Hebert Curtis Architects, LLC
501 Government Street, Suite 200
Baton Rouge, LA 70802

TABLE OF ARTICLES

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

INDEX
(Topics and numbers in bold are Section headings.)

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. The Contract Documents shall include the Bid Documents as listed in the Instructions to Bidders and any modifications made thereto by addenda.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and

enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form to establish the protocols for the development, use, transmission, and exchange of digital data.

(Paragraphs deleted)

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such

information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

(Paragraphs deleted)

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 The Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The term Architect, when used in the Contract Documents, shall mean the prime Designer (Architect, Engineer, or Landscape Architect), or his authorized representative, lawfully licensed to practice architecture, engineering, or landscape architecture in the State of Louisiana, identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

(Paragraph deleted)

§ 3.4.3 Contractor and its employees, officers, agents, representatives, and Subcontractors shall conduct themselves in an appropriate and professional manner, in accordance with the Owner's requirements, at all times while working on the Project. Any such individual who behaves in an inappropriate manner or who engages in the use of inappropriate language or conduct while on Owner's property, as determined by the Owner, shall by removed the from the Project at the Owner's request. Such individual shall not be permitted to return without the written permission of the Owner. The Owner shall not be responsible or liable to Contractor or any Subcontractor for any additional costs, expenses, losses, claims or damages incurred by Contractor or its Subcontractor as a result of the removal of an individual from the Owner's property pursuant to this Section. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.6.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

(Paragraph deleted)

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of State authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those

indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, during the course of the Work, the Contractor discovers human remains, unmarked burial or archaeological sites, burial artifacts, or wetlands, which are not indicated in the Contract Documents, the Contractor shall follow all procedures mandated by State and Federal law, including but not limited to La R.S. 8:671 et seq., the Office of Coastal Protection and Restoration, and Sections 401 & 404 of the Federal Clean Water Act. Request for adjustment of the Contract Sum and Contract Time arising from the existence of such remains or features shall be submitted in writing to the Owner pursuant to the Contract Documents.

§ 3.8 Allowances

(Paragraphs deleted)

§ 3.8.1 Allowances shall not be made on any of the Work.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor. Important communications shall be confirmed in writing. Other communications shall be similarly confirmed on written request in each case.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project. For projects with a contract sum greater than $1,000,000.00, the Contractor shall include with the schedule, for the Owner's and Architect's information, a network analysis to identify those tasks which are on the critical path, i.e., where any delay in the completion of these tasks will lengthen the project timescale, unless action is taken. A revised schedule shall be submitted with each Application and Certificate for Payment. Not payment shall be made until this schedule is received.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in accordance with the most recent schedules submitted to the Owner and Architect. If the Work is not on schedule, as determined by the Architect, and the Contractor fails to take action to bring the Work on schedule, then the Contractor shall be deemed in default under this Contract and the progress of the Work shall be deemed unsatisfactory. Such default may be considered grounds for termination by the Owner for cause in accordance with Section 14.2.

3.10.4 Submittal by the contract of a schedule or other documentation showing a completion date for his Work prior to the completion date stated in the contract shall not impose any obligation or responsibility on the Owner or Architect for the earlier completion date.

3.10.5 In the even the Owner employs a commissioning consultant, the Contractor shall cooperate fully in the commissioning process and shall require all subcontractors and other under his control to cooperate. The purpose of such services shall be to ensure that all systems perform correctly and interactively according to the provisions of the Contract Documents.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed. This requirement is of the essence of the contract. The Architect shall determine the value of these documents and this amount shall not be approved for payment to the Contractor until all of the listed documents are delivered to the Architect in good order, completely marked with field changes and otherwise complete in all aspects.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect

of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date final payment is due, and with the Owner's concurrence, from time to time during the one year period for correction of Work described in Section 12.2. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed to endeavor to guard the Owner against defects and deficiencies in the Work, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor may communicate directly with each other, when deemed necessary by the Owner, and the Owner will notify the Architect of any decision . The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives. There shall be no restriction on the Owner having a Representative.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests

will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If no agreement is made concerning the time within which interpretation required of the Architect shall be furnished in compliance with this Section 4.2, then delay shall not be recognized on account of failure by the Architect to furnish such interpretation until 15 days after written request is made for them.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If no agreement is made concerning the time within which interpretation required of the Architect shall be furnished in compliance with this Section 4.2, then delay shall not be recognized on account of failure by the Architect to furnish such interpretation until 15 days after written request is made for them.If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise required by the Contract Documents, the Contractor shall furnish at the Pre-Construction Conference, to the Owner and the Architect, in writing, the names of the persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work. No Contractor payments shall be made until this information is received.

§ 5.2.2 The Contractor shall be solely responsible for selection and performance of all subcontractors. The Contractor shall not be entitled to claims for additional time and/or an increase in contract sum due to a problem with performance or nonperformance of a subcontractor.

§ 5.2.3 The Contractor shall notify the Architect and the Owner when a subcontractor is to be changed and substituted with another subcontractor.

(Paragraph deleted)

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor,

prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

(Paragraphs deleted)

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

7.1.4 As part of the pre-construction conference submittals, the Contractor shall submit the following prior to the Contractor's initial request for payment:

7.1.4.1 Fixed job site overhead cost itemized with documentation to support daily rates.

7.1.4.2 Bond Premium Rate with supporting information from the General Contractor's carrier.

7.1.4.3 Labor Burden by trade for both Subcontractors and General Contractor. The Labor Burden shall be supported by the Worker's Compensation and Employer's Liability Insurance Policy Information Page. Provide for all trades.

7.1.4.4 Internal Rate Charges for all significant company owner equipment.

7.1.5 If the General Contractor fails to submit the aforementioned documentation as part of the pre-construction submittals, then pay application shall not be processed until such time as the Owner receives this information.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, the Architect, and the Contractor issued after execution of the Contract, authorizing a change in the Work and/or an adjustment in the Contract Sum and/or the Contract Time. The Contract Sum and the Contract Time may be changed only by Change Order. A Change Order signed by the Contractor indicates his agreement therewith, including the adjustment in the Contract Sum or the Contract Time. Any reservation of rights, stipulation or other modification made on the change order by the contractor shall have no effect.

7.2.2 "Cost of the Work" for the purpose of Change Orders shall be the eligible costs required to be incurred in performance of the Work and paid by the Contractor and Subcontractors which eligible costs shall be limited to:

7.2.2.1 Actual wages paid directly to labor personnel, with a labor burden markup exclusively limited to applicable payroll taxes, worker's compensation insurance, unemployment compensation, and social security taxes for those labor personnel performing the Work. Wages shall be the basic hourly labor rate paid an employee exclusive of fringe benefits or other employee costs. The labor burden percentage for the "cost of the Work" in limited to categories listed herein. Employer-provided health insurance, fringe benefits, employee training (whether a requirement of employment or not), vacation pay, etc., are examples of ineligible labor burden costs which *shall not* be included, as these costs are already compensated by the Overhead and Profit markup.

Supervision shall not be included as a line item in the "cost of the Work", except when the change results in a documented delay in the critical path, as described in Section 7.2.7.

7.2.2.2 Cost of all material and supplies necessary and required to perform the Work, identifying each item and its individual cost, including taxes. Incidental consumables are not eligible costs and shall not be included.

7.2.2.3 Cost of each necessary piece of machinery and equipment required to perform the Work, identifying each item and its individual cost, including taxes. Incidental small tools of a specific trade (i.e., shovels, saws, hammers, air compressor, etc.,) and general use vehicles, such as pickup trucks even for moving items around the site, fuel for these general use vehicles, travel, lodging, and/or meals are not eligible and shall not be included.

7.2.2.4 Eligible Insurance costs shall be limited to documented increase in "Builder's Risk" insurance premium / cost only. Commercial General Liability, Automobile Liability, and all other required insurances, where referenced in the Contract shall be considered part of normal overhead. These costs are already compensated by the Overhead and Profit markup.

7.2.2.5 Cost for the General Contractor Performance and Payment Bond premium, where the documented cost of the premiums have been increased due to the Change Order.

7.2.3 Overhead and Profit - The Contractor and Subcontractor shall be due home office fixed overhead and profits on the Cost of the Work, but shall not exceed a total of 16% of the direct cost of any portion of Work.

The credit to the Owner resulting from a change in the Work shall be the sum of those items above, including overhead and profit. Where a change results in both credits to the Owner and extras to the Contractor for related items, overhead and profit shall be computed for credits to the Owner and extras to the Contractor. The Owner shall receive full credit for the computed overhead and profit on credit change order items.

7.2.4 The cost to the Owner resulting from a change in the Work shall be the sum of: Cost of the Work (as defined at Section 7.2.2) and Overhead and Profit (as defined at Section 7.2.3), and shall be computed as follows:

7.2.4.1 When all of the Work is General Contractor Work; 8% markup on the Cost of the Work.

7.2.4.2 When the Work is all Subcontract Work; 8% markup on the Cost of the Work for Subcontractor's Overhead and Profit, plus 8% markup on the Cost of the Work, not including the Subcontractor's Overhead and Profit markup, for General Contractor's Overhead and Profit.

7.2.4.3 When the Work is a combination of General Contractor Work and Subcontract Work; that portion of the direct cost that is General Contract Work shall be computed per Section 7.2.4.1 and that portion of the direct cost that is Subcontract Work shall be computed per Section 7.2.4.2.

Premiums for the General Contractor's bond may be included, but after the markup is added to the Cost of the Work.
Premiums for the Subcontractor's Bond shall not be included.

7.2.4.4 Subcontract cost shall consist of the items in Section 7.2.2 above plus Overhead and Profit as defined in Section 7.2.3.

7.2.5 Before a Change Order is prepared, the Contractor shall prepare and deliver to the Architect the following information concerning the Cost of the Work, not subject to waiver, within a reasonable time after being notified to prepare said Change Order:

A detailed, itemized list of labor, material and equipment costs for the General Contractor's Work including quantities and unit costs for each item of labor, material and equipment.

An itemized list of labor, material and equipment costs for each Subcontractor's and/or Sub-Subcontractor's Work including quantities and unit costs for each item of labor, material and equipment.

7.2.6 After a Change Order has been approved, no future requests for extensions of time or additional cost shall be considered for that Change Order.

7.2.7 Extended fixed job-site costs are indirect costs that are necessary to support the work in the field. Examples of fixed job-site costs are field office rental, salaries of field office staff, field office

utilities, and telephone.

Extended fixed job-site costs or equitable adjustment may be included in a Change Order due to a delay in the critical path, with the exception of weather related delays. In the event of a delay in the critical path, the Contractor shall submit all changes or adjustments to the Contract Time **within twenty-one (21) days** of the event giving rise to the delay. The Contractor shall submit documentation and justification for the adjustment by performing a critical path analysis of its most recent schedule in use prior to the change, which shows an extension in critical path activities.
The Contractor shall notify the Architect in writing that the Contractor is making a claim for extended fixed job-site overhead as required by Section 15.1.2. The Contractor shall provide proof that the Contractor is unable to mitigate financial damages through Alternate Work within this Contract or replacement work. "Replacement Work" is that work which the Contractor is obligated to perform under any construction contract separate from this Contract. Reasonable proof shall be required by the Architect that the delays affected the Completion Date.

7.2.8 "Cost of the Work" whether General Contractor cost or Subcontractor cost shall not apply to the following:

7.2.8.1 Salaries or other compensation of the Contractor's personnel at the Contractor's principal office and branch offices.

7.2.8.2 Any part of the Contractor's capital expenses, including interest on the Contractor's capital employed for the Work.

7.2.8.3 Overhead and general expenses of any kind or the cost of any item not specifically and expressly included above in Cost of the Work.

7.2.8.4 Cost of supervision refer to section 7.2.2.1, with exception as provided in Section 7.2.7.

7.2.9 When applicable as provided by the Contract, the cost to Owner for Change Orders shall be determined by quantities and unit prices. The quantity of any item shall be as submitted by the Contractor and approved by the Architect. Unit prices shall cover cost of Material, Labor, Equipment, Overhead and Profit.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods, but not to exceed a specified amount:

.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
.2 Unit prices stated in the Contract Documents or subsequently agreed upon;
.3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
.4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and

profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

.1 Costs of labor, including social security, old age and employment insurance, applicable payroll taxes, and workers' compensation insurance; **.2** Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total costs of a Construction Change Directive to the Owner, amounts not in dispute for such changes in the Work shall be included in Applications for Payment accompanied by a Change Order indicating the parties' agreement with part or all of such costs.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

8.1.5 The Contract Time shall not be changed by the submission of a schedule that shows an early completion date unless specifically authorized by change order.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work. Completion of the Work must be within the Time for Completion stated in the Agreement, subject to such extensions as may be granted under Section 8.3. The Contractor agrees to commence Work not later than fourteen (14) days after the transmittal date of Written Notice to Proceed from the Owner and to substantially complete the project within the time stated in the Contract. The Owner will suffer financial loss if the project is not substantially complete in the time set forth in the Contract Documents. The Contractor and the Contractor's Surety shall be liable for and shall pay to the Owner the sum stated in the Contract Documents as fixed, agreed and liquidated damages for each consecutive calendar day (Saturdays, Sundays and holidays included) of delay until the Work is substantially complete. The Owner shall be entitled to the sum stated in the Contract Documents. Such Liquidated Damages shall be withheld by the Owner from the amounts due the Contractor for progress payments.

(Paragraph deleted)

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending litigation; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may recommend, subject to Owner's approval of Change order. If the claim is not made within the limits of Article 15, all rights for future claims for that month are waived..

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

9.2 SCHEDULE OF VALUES

At the Pre-Construction Conference, the Contractor shall submit to the Owner and the Architect a Schedule of Values prepared as follows:

9.2.1 The attached Schedule of Values Format shall be used. If applicable, the cost of Work for each section listed under each division, shall be given. The cost for each section shall include Labor, Materials, Overhead and Profit.

9.2.2 The Total of all items shall equal the Total Contract Sum. This schedule, when approved by the Architect, shall be used as a basis for the Contractor's Applications for Payment and it may be used for determining the cost of the Work in deductive change orders, when a specific item of Work listed

on the Schedule of Values is to be removed. Once the Schedule of Values is submitted at the Pre-Construction Conference, the schedule shall not be modified without approval from the Owner and Architect.

(Paragraphs deleted)

§ 9.3 Applications for Payment

9.3.1 Monthly, the Contractor shall submit to the Architect a Facility Planning and Control – Application and Certification for Payment form, supported by any additional data substantiating the Contractor's right to payment as the Owner or the Architect may require. Application for Payment shall be submitted on or about the first of each month for the value of labor and materials incorporated into the Work and of materials, suitably stored, at the site as of the twenty-fifth day of the preceding month, less normal retainage as follows, per La R.S. 38:2248:

9.3.1.1 Projects with Contract price up to $500,000.00 – 10% of the Contract price.

9.3.1.2 Projects with Contract price of $500,000.00, or more – 5% of the Contract price.

9.3.1.3 No payment shall be made until the revised schedule required by Section 3.10.1 is received.

9.3.1.4 The normal retainage shall not be due the Contractor until after substantial completion and expiration of the forty-five day lien period and submission to the Architect of a clear lien certificate, consent of surety, and invoice for retainage.

9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. Payments for materials or equipment stored on the site shall be conditioned upon submission by the Contractor of bills of sale or such other procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, including applicable insurance.

(Paragraphs deleted)

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor

deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- **.4** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- **.5** damage to the Owner or a Separate Contractor;
- **.6** reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- **.7** failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

(Paragraph deleted)

§ 9.6 Progress Payments

9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment within twenty days except for projects funded fully or in part by a Federal reimbursement program. For such projects the Owner will make payment in a timely manner consistent with reimbursement.

(Paragraph deleted)

§ 9.6.2 The Contractor shall pay each Subcontractor, after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner. La R.S. 9:2784 (A) and (C) require a Contractor or Subcontractor to make payment due to each Subcontractor and supplier within fourteen (14) consecutive days of the receipt of payment from the Owner. If not paid, a penalty in the amount of ½ of 1% per day is due, up to a maximum of 15% from the expiration date until paid. The contractor or subcontractor, whichever is applicable, is solely responsible for payment of a penalty.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law. Pursuant to La. R.S. 38:2242 and La. R.S. 38:2242.2, when the Owner receives any claim of nonpayment arising out of the Contract, the Owner shall deduct 125% of such claim from the Contract Sum. The Contractor, or any interested party, may deposit security, in accordance with La. R.S. 38:2242.2, guaranteeing payment of the claim with the recorder of mortgages of the parish where the Work has been done. When the Owner receives original proof of such guarantee from the recorder of mortgages, the claim deduction will be added back to the Contract Sum.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

9.8 SUBSTANTIAL COMPLETION

9.8.1 Substantial Completion is the stage in the progress of the Work when the Work is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use. The Architect shall determine if the project is substantially complete in accordance with this Section.

9.8.2 When the Contractor considers that the Work is Substantially Complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

9.8.3 Upon receipt of the Contractor's list, the Architect shall make an inspection to determine whether the Work is substantially complete. A prerequisite to the Work being considered as substantially complete is the Owner's receipt of the executed Roofing Contractor's and Roofing Manufacturer's guarantees, where roofing Work is part of the Contract. Prior to inspection by the Architect, the Contractor shall notify the Architect that the project is ready for inspection by the State Fire Marshal's office. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use, the Contractor shall, before the Work can be considered as Substantially Complete, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

9.8.4 When the Architect determines that the project is Substantially Complete, he shall

prepare a punch list of exceptions and the dollar value related thereto. The monetary value assigned to this list will be the sum of the cost estimate for each particular item of Work the Architect develops based on the mobilization, labor, material and equipment costs of correcting the item and shall be retained from the monies owed the contractor, above and beyond the standard lien retainage. The cost of these items shall be prepared in the same format as the schedule of values. At the end of the forty-five day lien period payment shall be approved for all punch list items completed up to that time. After that payment, none of the remaining funds shall be due the contractor until all punch list items are completed and are accepted by the Architect. If the dollar value of the punch list exceeds the amount of funds, less the retainage amount, in the remaining balance of the Contract, then the Project shall not be considered as substantially complete. If funds remaining are less than that required to complete the Work, the Contractor shall pay the difference.

9.8.5 When the preparation of the punch list is complete the Architect shall prepare a Recommendation of Acceptance incorporating the punch list and submit it to the Owner. Upon approval of the Recommendation of Acceptance, the Owner may issue a Notice of Acceptance of Building Contract which shall establish the Date of Substantial Completion. The Contractor shall record the Notice of Acceptance with the Clerk of Court in the Parish in which the Work has been performed. If the Notice of Acceptance has not been recorded seven (7) days after issuance, the Owner may record the Acceptance at the Contractor's expense. All additive change orders must be processed before issuance of the Recommendation of Acceptance. The Owner shall not be responsible for payment for any Work associated with change orders that is not incorporated into the contract at the time of the Recommendation of Acceptance.

9.8.6 Warranties required by the Contract Documents shall commence on the date of Acceptance of the Work unless otherwise agreed to in writing by the Owner and Contractor. Unless otherwise agreed to in writing by the Owner and Contractor, security, maintenance, heat, utilities, damage to the Work not covered by the punch list and insurance shall become the Owner's responsibility on the Date of Substantial Completion.

9.8.7 If all punch list items have not been completed by the end of the forty-five (45) day lien period, through no fault of the Architect or Owner, the Owner may hold the Contractor in default. If the Owner finds the Contractor is in default, the Surety shall be notified. If within forty-five (45) days after notification, the Surety has not completed the punch list, through no fault of the Architect or Owner, the Owner may, at his option, contract to have the balance of the Work completed and pay for such Work with the unpaid funds remaining in the Contract sum. Finding the Contractor in default shall constitute a reason for disqualification of the Contractor from bidding on future state contracts. If the surety fails to complete the punch list within the stipulated time period, the Owner may not accept bonds submitted, in the future, by the surety.

(Paragraphs deleted)

§ 9.9 Partial Occupancy or Use

9.9.1 Partial Occupancy is that stage in the progress of the Work when a designated portion of the Work is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the designated portion of the Work for its intended use. The Owner may occupy or use any substantially completed portion of the Work so designated by separate agreement with the Contractor and authorized by public authorities having jurisdiction over the Work. Such occupancy or use may commence provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers the designated portion substantially complete the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld.

(Paragraph deleted)

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

9.10.4 The making of final payment shall not constitute a waiver of Claims by the Owner for the following:

9.10.4.1 Claims, security interests, or encumbrances arising out of the Contract and unsettled;

9.10.4.2 failure of the Work to comply with the requirements of the Contract Documents irrespective of when such failure is discovered;

9.10.4.3 terms of special warranties required by the Contract Documents; or

9.10.4.4 audits performed by the Owner, after final payment.

(Paragraphs deleted)

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- **.1** employees on the Work and other persons who may be affected thereby;
- **.2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- **.3** other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing the health and, safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB) or lead, encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. The Contract time shall be extended appropriately.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

10.4 EMERGENCIES

In an emergency affecting the safety of persons or property, the Contractor shall notify the Owner and Architect immediately of the emergency, simultaneously acting at his discretion to prevent damage, injury or loss. Any additional compensation or extension of time claimed by the Contractor on account of emergency Work shall be determined as provided in Article 15 and Article 7.

INSURANCE REQUIREMENTS FOR NEW CONSTRUCTION, ADDITIONS AND RENOVATIONS

11.1 CONTRACTOR'S LIABILITY INSURANCE

The Contractor shall purchase and maintain without interruption for the duration of the contract insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the Work hereunder by the Contractor, its agents, representatives, employees or subcontractors. The duration of the contract shall be from the inception of the contract until the date of final payment.

11.2 MINIMUM SCOPE AND LIMITS OF INSURANCE

11.2.1 Worker's Compensation

Worker's Compensation insurance shall be in compliance with the Worker's Compensa-tion law of the Contractor's headquarters. Employers Liability is included with a minimum limit of $1,000,000 per accident/per disease/per employee. If Work is to be performed over water and involves maritime exposure, applicable LHWCA, Jones Act or other maritime law coverage shall be included. A.M. Best's insurance company rating requirement may be waived for Worker's compensation coverage only.

11.2.2 Commercial General Liability

Commercial General Liability insurance, including Personal and Advertising Injury Liability and Products and Completed Operations Liability, shall have a minimum limit per occurrence based on the project value. The Insurance Services Office (ISO) Commercial General Liability occurrence coverage form CG 00 01 (current form approved for use in Louisiana), or equivalent, is to be used in the policy. Claims-made form is unacceptable.

The aggregate loss limit must apply to each project. ISO form CG 25 03 (current form approved for use in Louisiana), or equivalent, shall also be submitted. The State project number, including part number, and project name shall be included on this endorsement.

COMBINED SINGLE LIMIT (CSL) PER OCCURRENCE

Type of Construction	**Projects up to $1,000,000**	**Projects over $1,000,000 up to $10,000,000**	**Projects over $10,000,000**
New Buildings:			
Each Occurrence Minimum Limit	$1,000,000	$2,000,000	$4,000,000
Per Project Aggregate	$2,000,000	$4,000,000	$8,000,000
Renovations:	**The building(s) value for the Project is $_____.**		
Each Occurrence Minimum Limit	$1,000,000**	$2,000,000**	$4,000,000**
Per Project Aggregate	2 times per occur limit**	2 times per occur limit**	2 times per occur limit**

**While the minimum Combined Single Limit of $1,000,000 is required for any renovation, the limit is calculated by taking 10% of the building value and rounding it to the nearest $1,000,000 to get the insurance limit. Example: Renovation on a $33,000,000 building would have a calculated $3,000,000 combined single limit of coverage (33,000,000 times .10 = 3,300,000 and then rounding down to $3,000,000). If the calculated limit is less than the minimum limit listed in the above chart, then the amount needed is the minimum listed in the chart. Maximum per occurrence limit required is $10,000,000 regardless of building value. The per project aggregate limit is then calculated as twice the per occurrence limit.

11.2.3 Automobile Liability

Automobile Liability Insurance shall have a minimum combined single limit per occurrence of $1,000,000. ISO form number CA 00 01 (current form approved for use in Louisiana), or equivalent, is to be used in the policy. This insurance shall include third-party bodily injury and property damage liability for owned, hired and non-owned

automobiles.

11.2.4 Excess Umbrella

Excess Umbrella Insurance may be used to meet the minimum requirements for General Liability and Automobile Liability only.

11.2.5 Builder's Risk

11.2.5.1 Builder's Risk Insurance shall be in an amount equal to the amount of the construction contract including any amendments and shall be upon the entire Work included in the contract. The policy shall provide coverage equivalent to the ISO form number CP 10 20, Broad Form Causes of Loss (extended, if necessary, to include the perils of wind, earthquake, collapse, vandalism/malicious mischief, and theft, including theft of materials whether or not attached to any structure). The policy must include architects' and engineers' fees necessary to provide plans, specifications and supervision of Work for the repair and/or replacement of property damage caused by a covered peril, not to exceed 10% of the cost of the repair and/or replacement.

11.2.5.2 Flood coverage shall be provided by the Contractor on the first floor and below for all projects, except as otherwise noted. The builder's risk insurance policy, sub-limit for flood coverage shall not be less than ten percent (10%) of the total contract cost per occurrence. If flood is purchased as a separate policy, the limit shall be ten percent (10%) of the total contract cost per occurrence (with a max of $500,000 if NFIP). Coverage for roofing projects shall **not** require flood coverage.

11.2.5.3 A Specialty Contractor may provide an installation floater in lieu of a Builder's Risk policy, with the similar coverage as the Builder's Risk policy, upon the system to be installed in an amount equal to the amount of the contract including any amendments. Flood coverage is not required.

11.2.5.4 The policy must include coverage for the Owner, Contractor and any subcontractors as their interests may appear.

11.2.6 Pollution Liability *(required when asbestos or other hazardous material abatement is included in the contract)*

Pollution Liability insurance, including gradual release as well as sudden and accidental, shall have a minimum limit of not less than $1,000,000 per claim. A claims-made form will be acceptable. A policy period inception date of no later than the first day of anticipated Work under this contract and an expiration date of no earlier than 30 days after anticipated completion of all Work under the contract shall be provided. There shall be an extended reporting period of at least 24 months, with full reinstatement of limits, from the expiration date of the policy if the policy is not renewed. The policy shall not be cancelled for any reason, except non-payment of premium.

11.2.7 Deductibles and Self-Insured Retentions

Any deductibles or self-insured retentions must be declared to and accepted by the Owner. The Contractor shall be responsible for all deductibles and self-insured retentions.

11.3 OTHER INSURANCE PROVISIONS

11.3.1 The policies are to contain, or be endorsed to contain, the following provisions:

11.3.1.1 Worker's Compensation and Employers Liability Coverage

11.3.1.1.1 To the fullest allowed by law, the insurer shall agree to waive all rights of subrogation against the Owner, its officers, agents, employees and volunteers for losses arising from Work performed by the Contractor for the Owner.

11.3.1.2 Commercial General Liability Coverage

11.3.1.2.1 The Owner, its officers, agents, employees and volunteers are to be added as additional insureds as respects liability arising out of activities performed by or on behalf of the Contractor; products and completed operations of the Contractor, premises owned, occupied or used by the Contractor. ISO Form CG 20 10 (for ongoing work) AND CG 20 37 (for completed work) (current forms approved for use in Louisiana), or equivalent, are to be used.

11.3.1.2.2 The Contractor's insurance shall be primary as respects the Owner, its officers, agents, employees and volunteers for any and all losses that occur under the contract. The coverage shall contain no special limitations on the scope of protection afforded to the Owner, its officers, officials, employees or volunteers. Any insurance or self-insurance maintained by the Owner shall be excess and non-contributory of the Contractor's insurance.

11.3.1.3 Builder's Risk

The policy must include an endorsement providing the following:

In the event of a disagreement regarding a loss covered by this policy, which may also be covered by a State of Louisiana self-insurance or commercial property policy through the Office of Risk Management (ORM), Contractor and its insurer agree to follow the following procedure to establish coverage and/or the amount of loss:

Any party to a loss may make written demand for an appraisal of the matter in disagreement. Within 20 days of receipt of written demand, the Contractor's insurer and either ORM or its commercial insurance company shall each select a competent and impartial appraiser and notify the other of the appraiser selected. The two appraisers shall select a competent and impartial umpire. The appraisers shall then identify the policy or policies under which the loss is insured and, if necessary, state separately the value of the property and the amount of the loss that must be borne by each policy. If the two appraisers fail to agree, they shall submit their differences to the umpire. A written decision by any two shall determine the policy or policies and the amount of the loss. Each insurance company agrees that the decision of the appraisers and the umpire if involved shall be binding and final and that neither party will resort to litigation. Each of the two parties shall pay its chosen appraiser and bear the cost of the umpire equally.

11.3.1.4 All Coverages

11.3.1.4.1 All policies must be endorsed to require 30 days written notice of cancellation to the Agency. Ten-day written notice of cancellation is acceptable for non-payment of premium. Notifications shall comply with the standard cancellation provisions in the Contractor's policy. In addition, Contractor is required to notify Agency of policy cancellations or reductions in limits.

11.3.1.4.2 Neither the acceptance of the completed Work nor the payment thereof shall release the Contractor from the obligations of the insurance requirements or indemnification agreement.

11.3.1.4.3 The insurance companies issuing the policies shall have no recourse against

the Owner for payment of premiums or for assessments under any form of the policies.

11.3.1.4.4 Any failure of the Contractor to comply with reporting provisions of the policy shall not affect coverage provided to the Owner, its officers, agents, employees and volunteers.

11.3.2 Acceptability of Insurers

All required insurance shall be provided by a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located. Insurance shall be placed with insurers with an A.M. Best's rating of **A-: VI or higher**. This rating requirement may be waived for Worker's compensation coverage only.

If at any time an insurer issuing any such policy does not meet the minimum A.M. Best rating, the Contractor shall obtain a policy with an insurer that meets the A.M. Best rating and shall submit another certificate of insurance within 30 days.

11.3.3 Verification of Coverage

Contractor shall furnish the Owner with Certificates of Insurance reflecting proof of required coverage. The Certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf. The Certificates are to be received and approved by the Owner before Work commences and upon any contract renewal or insurance policy renewal thereafter. The Certificate Holder must be listed as follows:

State of Louisiana
Name of Owner
Owner Address
City, State, Zip
Attn: Project # _____

The Owner reserves the right to request complete certified copies of all required insurance policies at any time.

Upon failure of the Contractor to furnish, deliver and maintain required insurance, this contract, at the election of the Agency, may be suspended, discontinued, or terminated. Failure of the Contractor to purchase and/or maintain any required insurance shall not relieve the Contractor from any liability or indemnification under the contract.

If the Contractor does not meet the insurance requirements at policy renewal, at the option of the Owner, payment to the Contractor may be withheld until the requirements have been met, OR the Owner may pay the renewal premium and withhold such payment from any monies due the Contractor, OR the contract may be suspended or terminated for cause.

11.3.4 Subcontractors

Contractor shall include all subcontractors as insureds under its policies OR shall be responsible for verifying and maintaining the certificates provided by each subcontractor. Subcontractors shall be subject to all of the requirements stated herein. The Owner reserves the right to request copies of subcontractor's certificates at any time.

If Contractor does not verify subcontractors' insurance as described above, Owner has the right to withhold payments to the Contractor until the requirements have been met.

11.3.5 Worker's Compensation Indemnity

In the event Contractor is not required to provide or elects not to provide Worker's compensation coverage, the parties hereby agree the Contractor, its Owners, agents and employees shall have no cause of action against, and shall not assert a claim against, the State of Louisiana, its departments, agencies, agents and employees as an employer, whether pursuant to the Louisiana Worker's Compensation Act or otherwise, under any circumstance. The parties also hereby agree that the State of Louisiana, its departments, agencies, agents and employees shall in no circumstance be, or considered as, the employer or statutory employer of Contractor, its Owners, agents and employees. The parties further agree that Contractor is a wholly independent Contractor and is exclusively responsible for its employees, Owners, and agents. Contractor hereby agrees to protect, defend, indemnify and hold the State of Louisiana, its departments, agencies, agents and employees harmless from any such assertion or claim that may arise from the performance of this contract.

11.3.6 Indemnification/Hold Harmless Agreement

Contractor agrees to protect, defend, indemnify, save, and hold harmless, the State of Louisiana, all State Departments, Agencies, Boards and Commissions, its officers, agents, servants, employees and volunteers, from and against any and all claims, damages, expenses and liability arising out of injury or death to any person or the damage, loss or destruction of any property which may occur, or in any way grow out of, any act or omission of Contractor, its agents, servants and employees, or any and all costs, expenses and/or attorney fees incurred by Contractor as a result of any claims, demands, suits or causes of action, except those claims, demands, suits or causes of action arising out of the negligence of the State of Louisiana, all State Departments, Agencies, Boards, Commissions, its officers, agents, servants, employees and volunteers.

Contractor agrees to investigate, handle, respond to, provide defense for and defend any such claims, demands, suits or causes of action at its sole expense and agrees to bear all other costs and expenses related thereto, even if the claims, demands, suits, or causes of action are groundless, false or fraudulent. The State of Louisiana may, but is not required to, consult with the Contractor in the defense of claims, but this shall not affect the Contractor's responsibility for the handling and expenses of all claims.

11.4 PERFORMANCE AND PAYMENT BOND

11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

11.4.3 Recordation of Contract and Bond [La R.S. 38:2241 thru 38:2241.1]

The Owner shall record within thirty (30) days the Contract Between Owner and Contractor and Performance and Payment Bond with the Clerk of Court in the Parish in which the Work is to be performed.

(Paragraphs deleted)

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense. If the Contractor fails to correct Work identified as defective within a thirty (30) day period, through no fault of the Designer, the Owner may hold the Contractor in default. If the Owner finds the Contractor in default, the Surety shall be notified. If within thirty (30) days after notification, the Surety has not corrected the nonconforming Work, through no fault of the Architect or Owner, the Owner may contract to have nonconforming Work corrected and hold the Surety and Contractor responsible for the cost, including architectural fees and other indirect costs. If the Surety fails to correct the Work within the stipulated time period and fails to meet its obligation to pay the costs, the Owner may elect not to accept bonds submitted in the future by the Surety. Finding the Contractor in default shall constitute a reason for disqualification of the Contractor from bidding on future state contracts.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work, or Work covered by warranties, within a thirty (30) day period, through no fault of the Architect or Owner, the Owner may hold the Contractor in default. If the Owner finds the Contractor is in default, the Surety shall be notified. If within thirty (30) days after notification, the Surety has not corrected the non-conforming or warranty Work, through no fault of the Architect or Owner, the Owner may contract to have the nonconforming or warranty Work corrected and hold the Surety responsible for the cost including architects fees and other indirect costs. Corrections by the Owner shall be in accordance with Section 2.4. If the Surety fails to correct the nonconforming or warranty Work within the stipulated time period and fails to meet its obligation to pay the costs, the Owner may not accept bonds submitted, in the future, by the Surety.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

(Paragraph deleted)

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

13.3.3 The Nineteenth Judicial Court in and for the Parish of East Baton Rouge, State of Louisiana shall have sole jurisdiction and venue in any action brought under this contract.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. The Contractor shall make arrangements for such tests, inspections and approvals with the Testing Laboratory provided by the Owner, and the Owner shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

(Paragraphs deleted)

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- **.3** Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

(Paragraph deleted)

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit for Work completed prior to stoppage , and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- **.1** repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- **.2** fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- **.3** repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- **.4** otherwise is guilty of substantial breach of a provision of the Contract Documents.
- .5 failure to complete the punch list within the lien period as provided in 9.8.7.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to Section 5.4; and

.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work. Termination by the Owner shall not suspend assessment of liquidated damages against the Surety

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

14.2.5 If an agreed sum of liquidated damages has been established, termination by the Owner under this Article shall not relieve the Contractor and/or Surety of his obligations under the liquidated damages provisions and the Contractor and/or Surety shall be liable to the Owner for per diem liquidated damages.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, along with reasonable profit on the work not executed.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility

to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. A Reservation of Rights and similar stipulations shall not be recognized under this contract as having any effect. A party must make a claim as defined herein within the time limits provided.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Architect's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with his/her decision..

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

15.1.6.2 If adverse weather conditions are the basis for a claim for additional time, the Contractor shall document that weather conditions had an adverse effect on the scheduled construction. An increase in the contract time due to weather shall not be cause for an increase in the contract sum. At the end of each month, the Contractor shall make one Claim for any adverse weather days occurring within the month. The Claim must be accompanied by sufficient documentation evidencing the adverse days and the impact on construction. Failure to make such Claim within twenty-one (21) days from the last day of the month shall prohibit any future claims for adverse days for that month. No additional adverse weather days shall be granted after the original or extended contract completion date, except those adverse weather days associated with a National Weather Service named storm or federally declared weather related disaster directly affecting the project site.

15.1.6.3 The following are considered reasonably anticipated days of adverse weather on a monthly basis:

January	11 days	July	6 days
February	10 days	August	5 days
March	8 days	September	4 days
April	7 days	October	3 days

May	5 days	November	5 days
June	6 days	December	8 days

The Contractor shall ask for total adverse weather days. The Contractor's request shall be considered only for days over the allowable number of days stated above.

Note: Contract is on a calendar day basis.

(Paragraph deleted)

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect shall always serve as the Initial Decision Maker. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim arising prior to the date final payment is due. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties except that the Owner may reject the decision or suggest a compromise or both .

(Paragraphs deleted)

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

(Paragraphs deleted)

SECTION 00 0009 - SPECIAL CONDITIONS

GENERAL

1.01 INSURANCE REQUIREMENTS FOR CONSTRUCTION OF BUILDINGS

A. All policies and certificates of insurance of the Contractor/Subcontractor shall contain the following clauses:
   1. The Contractor/Subcontractor's insurer will have no right of recovery or subrogation against the owner or the Architect, it being the intention of the parties that the insurance policies so affected shall protect both parties and the primary coverage for any and all losses covered by the below described insurance.
   2. The Owner and Architect shall be named as an additional insured as regards negligence by the contractor (ISO Forms CG 20 10 11 85).
   3. The Contractor shall, before commencing any work to be conducted under this Contract, procure Workmen's Compensation and Employer's Liability Insurance affording coverage under the statutory provisions of the Workmen's Compensation laws and any other compensation or common law liability pertaining to the operations to be performed under this Contract, with an insurance company authorized to write such policies of insurance in the State of Louisiana. It shall be the further responsibility of the Contractor to require that all subcontractors have in full force and effect a policy of Workmen's Compensation and Employer's Liability Insurance before proceeding with any of the work required under this Contract.
   4. The Contractor shall procure and maintain, during the life of the contract, such public liability and property damage insurance, including the operation of motor vehicles, with limits as hereinafter provided, which will cover the Contractor's, Owner's and Architect's legal liability arising out of the work performed by the Contractor and any Subcontractor, and by anyone directly or indirectly employed by either of them for claims for damages for personal injury, including accidental death as well as claims for property damages, which may arise from operations under this Contract.

B. The following items of insurance, amounts of coverage, etc. shall be furnished by the Contractor.
   1. Worker's Compensation and Employer's Liability. The Contractor shall furnish evidence that he is carrying Workers' Compensation and Employer's Liability Insurance on all of his employees in amounts as set forth in the Louisiana Workers' Compensation Act with minimum $100,000 Employer's Liability limits as follows:
      a. Workers' Compensation-Statutory basis for Louisiana
         1) Employers Liability:
         2) $500,000 bodily injury by accident-each accident;
         3) $500,000 bodily injury by disease-each employee;
         4) $500,000 bodily injury by disease-policy limit.
   2. Comprehensive General Liability. The Contractor will provide Comprehensive General Liability Insurance on the project with limits as follows:
      a. Commercial General Liability
         1) $2,000,000 general aggregate
         2) $2,000,000 products/completed operations aggregate
         3) $1,000,000 personal or advertising injury
         4) $1,000,000 each occurrence
         5) Including contractual liability coverage
      b. Coverage must be extended to cover all hazards such as:
         1) Operations, premises.
         2) Contractor's Protective Liability (will cover Subcontractor's Liability).
         3) Owner's Protective Liability.
         4) Architect's Protective Liability.
         5) Completed Operations - Products.
         6) Contractual Liability.

7) Contractor must have "XCU" (Explosion, Collapse, Underground) exclusions eliminated.
8) Contractor must provide Products or Completed Operations coverage listed above for a term of one (1) year after the date of substantial completion of the project.
9) Contractor must provide evidence of assumption of Contractual Liability imposed by Hold Harmless paragraph.

3. Comprehensive Automobile Liability. Contractor will provide Bodily Injury Liability in the amount of $1,000,000 each person, $1,000,000 Bodily Injury - all persons in one occurrence, and $1,000,000 Property Damage Liability and will include Non-owned and Hired Car Liability in the same limits, and all vehicles, whether leased, owned, hired, as well as non-owned vehicles used for the job, must be protected as outlined above.
4. The contractor must carry the following coverages with minimum limits as shown:
   a. Commercial General Liability
      1) Commercial Automobile Liability-
         (a) $1,000,000 combined single limit
            (1) Including all owned, hired and borrowed vehicles
      2) Umbrella or Excess Liability:
         (a) Contract Value, Less than $500,000.00
            (1) $1,000,000.00
         (b) Contract Value, $500,000.00 to $2,000,000.00
            (1) $2,000,000.00
         (c) Contract Value, Greater than $2,000,000.00
            (1) Equal to, or greater than Contract Value
         (d) Including excess coverage for general liability, automobile liability, and employer's liability.
5. It shall be the further responsibility of the Contractor to require that all subcontractors have in full force and effect general liability, automobile liability, and workers' compensation insurance.
6. All required coverages to be provided by the contractor must:
   a. Name the Owner as additional insureds.
   b. Be primary insurance.
   c. Contain a waiver of transfer of rights of recovery in favor of the Owner.
   d. Be evidenced by a certificate of insurance provided to the parish prior to the commencement of the project naming the Owner.
   e. Be in effect at minimum required limits for at least two (2) years past the construction completion date.
   f. Be on an occurrence basis.
   g. Be written with an insurer that has a Best's rating of no less than "A-" and a financial size category of no less than "VI" according to the most recent edition of Best's Insurance Reports at the time the certificate of insurance is submitted to the Owner.

1.02 BUILDER'S RISK (GENERAL CONTRACTOR)

A. 'All Risk" (Standard form as approved by the state in which the work is performed) in an amount equal to 100% of the value of the Contract Sum written in the name of the General Contractor and Owner as their interest may appear.

B. The Owner does not waive any not waive any rights of recovery against the Contractor and/or Subcontractor for damages that are covered by the Owner's property insurance coverage of builders' risk coverage.

1.03 PROPERTY INSURANCE

A. The Contractor shall provide Property Insurance coverage and/or shall be
   1. Contractor's machinery and equipment.
   2. Materials and work stored off site or in transit.

1.04 PERFORMANCE BOND & PAYMENT BOND

A. The Contractor shall furnish and pay for a Performance and Payment Bond written by a company licensed to do business in Louisiana, which shall be signed by the surety's agent or attorney-in-fact, in an amount equal to 100% of the Contract amount. Surety must be listed currently on the U. S. Department of Treasury Financial Management Service List (Treasury List) as approved for an amount equal to or greater than the contract amount, or must be an insurance company domiciled in Louisiana or owned by Louisiana residents. If surety is qualified other than by listing on the Treasury list, the contract amount may not exceed fifteen percent of policyholders' surplus as shown by surety's most recent financial statements filed with the Louisiana Department of Insurance and may not exceed the amount of $500,000. However, a Louisiana domiciled insurance company with at least an A- rating in the latest printing of the A. M. Best's Key Rating Guide shall not be subject to the $500,000 limitation, provided that the contract amount does not exceed ten percent of policyholders' surplus as shown in the latest A. M. Best's Key Rating Guide nor fifteen percent of policyholders' surplus as shown by surety's most recent financial statements filed with the Louisiana Department of Insurance. The Bond shall be signed by the surety's agent or attorney-in-fact. The Bond shall be in favor of the Owner.

B. The Bidder shall require the Attorney-in-Fact who executes the required bond on behalf of the surety to affix thereto a certified and current copy of his power of Attorney.

END OF SECTION

SECTION 00 0010 - NOTICE OF AWARD

Date of Award: _____

TO: Contractor

ADDRESS: Address
City, State Zip

PROJECT: Specialty Surgical Hospital

Grace Hebert Curtis Architects, LLC Project No.: 6022158

Contract For: Stumberg Medical, LLC
P.O. Box 80063
Baton Rouge, LA 70898

You are notified that your Bid dated Bid Date for the above Contract has been considered. You are the apparent Successful Bidder and have been awarded a Contract for: Specialty Surgical Hospital.

The Contract Price of your Contract is: Contract Price Words & NOS.

This price includes Alternates numbered:

Three original contracts accompany this Notice of Award.

You must comply with the following conditions precedent within fifteen (15) days of the date of this Notice of Award, this is by: Date Signed Contracts Due.

1. You must deliver to the Architect three (3) fully executed original Contract documents. Each original of the Contract must bear your signature on all signatory lines within the Agreement

2. You must deliver with the executed contract, the signed Notice of Award, the required Performance and Payment Bonds and the required Insurance Certificates, (verifying additional insurer as required), and specified in Specification Section 00 0009 Special Conditions.

Failure to comply with these conditions within the time specified will entitle the Owner to consider your bid in default, to annul this Notice of Award and to declare your Bid Security forfeited.

Within ten (10) days after you comply with the above conditions, the Owner will return to you one (1) fully signed counterpart of the Agreement and Notice to Proceed.

_____
(Owner)

By: _____
(Authorized Signature)

_____
(Title)

ACCEPTANCE OF AWARD

_____
(Contractor)

By: _____
(Authorized Signature)

_____
(Title)

_____
(Date)

SECTION 00 0011 – NOTICE TO PROCEED

TO: Contractor

ADDRESS: Address
City, LA Zip

PROJECT: Specialty Surgical Hospital

Grace Hebert Curtis Architects LLC, Project Number: 6022158

Contract For: Stumberg Medical, LLC
P.O. Box 80063
Baton Rouge, LA 70898

You are notified that the Contract Times under the above Contract will commence to run on TBD. By that date, you are to start performing your obligations under the Contract Documents. The date of Substantial Completion is: TBD.

Also, before you may start any Work at the site you must notify Architect of Start Date.

_____
(Owner)

By: _____
(Authorized Signature)

_____
(Title)

ACKNOWLEDGED:

_____
(Contractor)

By: _____
(Authorized Signature)

_____
(Title)

_____
(Date)

SECTION 00 0200 – APPLIED TECHNOLOGY COUNCIL (ATC) WINDSPEED DETERMINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Applied Technology Council (ATC) Windspeed Determination for the Specialty Surgical Hospital site located at 6330 Mourning Dove Drive, Baton Rouge, LA 70816.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Hazards by Location

Search Information

Address: 6330 Mourning Dove Dr, Baton Rouge, LA 70816, USA

Coordinates: 30.39182780000001, -91.0385106

Elevation: 25 ft

Timestamp: 2023-06-29T03:55:49.955Z

Hazard Type: Wind

ASCE 7-16

MRI 10-Year	76	mph
MRI 25-Year	86	mph
MRI 50-Year	96	mph
MRI 100-Year	104	mph
Risk Category I	116	mph
Risk Category II	125	mph
Risk Category III	134	mph

If the structure under consideration is a healthcare facility and you are also within 1 mile of the coastal mean high water line, you are in a wind-borne debris region. If other occupancy, use the Risk Category II basic wind speed contours to determine if you are in a wind-borne debris region.

Risk Category IV	139	mph

You are in a wind-borne debris region if you are also within 1 mile of the coastal mean high water line.

ASCE 7-10

MRI 10-Year	76	mph
MRI 25-Year	88	mph
MRI 50-Year	97	mph
MRI 100-Year	105	mph
Risk Category I	116	mph
Risk Category II	125	mph
Risk Category III-IV	134	mph

If the structure under consideration is a healthcare facility and you are also within 1 mile of the coastal mean high water line, you are in a wind-borne debris region. If other occupancy, use the Risk Category II basic wind speed contours to determine if you are in a wind-borne debris region.

ASCE 7-05

ASCE 7-05 Wind Speed	107	mph

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

While the information presented on this website is believed to be correct, ATC and its sponsors and contributors assume no responsibility or liability for its accuracy. The material presented in the report should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. ATC does not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the report provided by this website. Users of the information from this website assume all liability arising from such use. Use of the output of this website does not imply approval by the governing building code bodies responsible for building code approval and interpretation for the building site described by latitude/longitude location in the report.

SECTION 00 0210 – FEMA FIRMETTE WITH FLOOD ZONE DETERMINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. FEMA FIRMette with Flood Zone Determination for the Specialty Surgical Hospital site located at 6330 Mourning Dove Drive, Baton Rouge, LA 70816.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Louisiana State Plane south zone (FIPSZONE 1702). The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was provided in digital format by East Baton Rouge Parish.

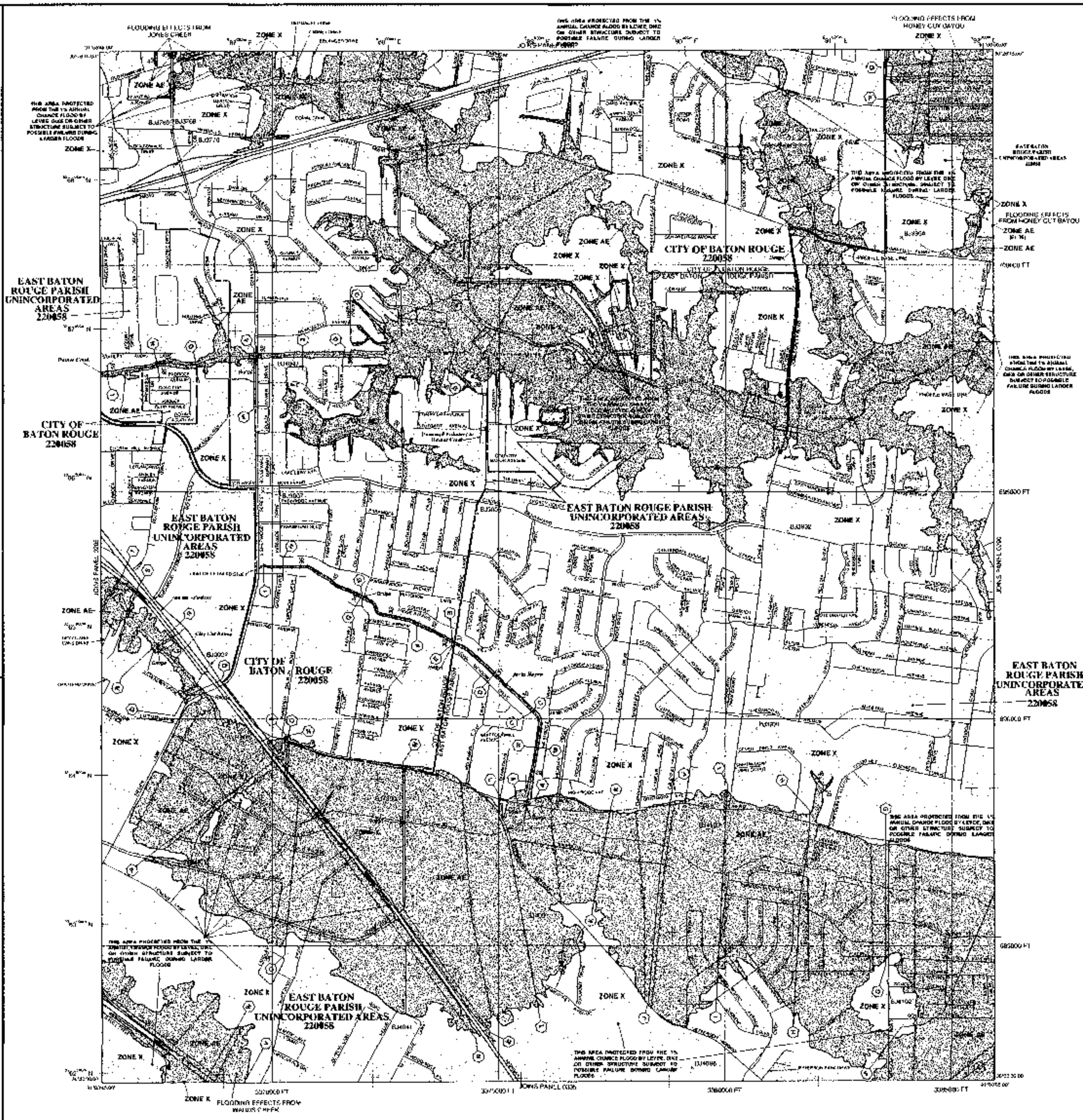
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~ 513 ~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

(A)——(A)	Cross section line
(23)——(23)	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}N$	1000-meter Universal Transverse Mercator grid ticks, zone 15
6000000 FT	5000-foot grid values: Louisiana State Plane coordinate system, south zone (FIPSZONE 1702), Lambert Conformal Conic
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
May 2, 2008
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

PANEL 0270E

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EAST BATON ROUGE PARISH, LOUISIANA
AND INCORPORATED AREAS

PANEL 270 OF 360
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EAST BATON ROUGE PARISH	220058	0270	E
BATON ROUGE, CITY OF	220058	0270	E

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
22033C0270E

EFFECTIVE DATE
MAY 2, 2008

Federal Emergency Management Agency

SECTION 00 0900 – GEOTECHNICAL REPORT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Geotechnical Report for Proposed Specialty Surgical Hospital site located at 6330 Mourning Dove Drive in Baton Rouge, LA 70816 as prepared by Premier Geotech and Testing, LLC and dated May 12, 2023 (57 pages).
2. Geotechnical Addendum 01 Report for Proposed Specialty Surgical Hospital site located at 6330 Mourning Dove Drive in Baton Rouge, LA 70816 as prepared by Premier Geotech and Testing, LLC. and dated May 19, 2023 (4 pages).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

SECTION 00 0001 – TABLE OF CONTENTS

Volume 1

SECTION 00 0001 – TABLE OF CONTENTS

SECTION 00 0001 – TABLE OF CONTENTS

END OF SECTION

SECTION 00 0001 – TABLE OF CONTENTS

Volume 1

SECTION 00 0001 – TABLE OF CONTENTS

SECTION 00 0001 – TABLE OF CONTENTS

END OF SECTION

SECTION 01 1000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Construction Areas.
4. Access to site.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Specialty Surgical Hospital

1. Project Location: 6330 Mourning Dove Drive, Baton Rouge, Louisiana 70816

B. Owner: Stumberg, Medical, LLC; P.O. Box 80063, Baton Rouge, Louisiana 70898.

C. Architect: Grace Hebert Curtis Architects, LLC; 501 Government Street, Suite 200, Baton Rouge, Louisiana 70802

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The Specialty Surgical Hospital project is a new construction, free-standing surgical hospital and medical office building of approximately 43,450 square feet for specialty surgeries. The project is located in Baton Rouge, LA. The facility will include new parking for staff, patients, and visitors.
2. Structural systems to accommodate scope of work.
3. Mechanical, Plumbing, Electrical and Fire Protection systems to accommodate scope of work.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.4 CONSTRUCTION AREAS

A. The Work shall be conducted in areas as indicated within the drawings.

1. Contractor to submit a site plan indicating lay down areas, location of dumpsters, temporary toilets, etc. for Architect and Owner’s approval prior to commencing Work.
2. Before commencing Work within each area, submit an updated copy of Contractor's construction schedule showing the sequence, commencement and completion dates for all areas of the Work.

1.5 ACCESS TO SITE

A. General: Contractor shall have use of Project site for construction operations during construction period as indicated.

B. Use of Site: Limit use of Project site to work in areas indicated in Construction Area drawings. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to the limits indicated.
2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    a. Schedule deliveries to minimize impacts to adjacent roadways by construction operations. Do not obstruct roadways, sidewalks or other public ways without permit.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.6 OWNER SUPPLIED EQUIPMENT

A. The Owner will supply and install the following equipment. Contractor to coordinate adjacent work for clear dimensions and shall request cut sheets or existing dimensions for such coordination prior to fabrication and installation of surrounding work:
    1. Furniture
    2. Printer/Copier
    3. Medical Equipment

1.7 COORDINATION WITH OCCUPANTS

A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
    1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
    2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
    3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
    4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

B. Cooperate with Owner to minimize conflict and facilitate Owner’s operations.

C. Schedule the Work to accommodate Owner occupancy.

1.8 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.
    1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Work hours shall occur within the requirements of authorities having jurisdiction and shall comply with all noise ordinances. Work after 5:00 pm and before 7:00am and work occurring on weekends shall be coordinated with Ochsner Security

C. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

D. Employee Screening: Comply with Owner's requirements for drug screening of Contractor personnel working on Project site.
    1. Maintain list of approved screened personnel with Owner's representative.

1.9 EXAMINATION OF SITE

A. Examination of Documents and Site: Contractor shall carefully examine Documents and Construction Site to obtain first-hand knowledge of scope and the conditions of the Work. The Contractor, by signing a Contract to perform the Work, represents and warrants that he has examined Drawings, Specifications and site of the Work and from his own investigation has satisfied himself as to scope, accessibility, nature and location of Work, character of equipment and other facilities needed for performance of work, character and extent of work to be performed, local availability, practices, and jurisdiction and other circumstances that affect performance of work. Contractor shall make sufficient investigation to ascertain that existing conditions are as represented on the Drawings and that the final results can be achieved as shown on the Drawings. No additional compensation will be allowed by the Owner for failure of Contractor to fully inform himself as to conditions affecting work. Dimensions and conditions of existing buildings shown on the Drawings are taken from original construction documents and may not represent actual conditions, and should be assumed to be approximate. The Contractor shall verify ALL existing dimensions and conditions, which would affect new work or renovations before proceeding with actual construction. Contractor will not be entitled to additional compensation if existing dimensions or conditions vary from that shown on the Contract Documents

B. Contractor's Representation: By executing the Contract, the Contractor represents that he has:

1. Visited the site.
2. Made due allowances for difficulties and contingencies to be encountered, including, but not limited to environmental restrictions, if any.
3. Compared Contract Documents with work in place.
4. Informed himself of existing conditions; and,
5. Notified the Architect of ambiguities, inconsistencies, and errors discovered in the Contract Documents, or between the Contract Documents and existing conditions.
6. Responsibility: Failure to visit the site and perform attendant responsibilities listed above shall not relieve the Contractor or any Subcontractor from their obligations, and no extra payment will be authorized for work related to conditions which can be determined by examination of the site and the Contract Documents

1.10 PROTECTION OF PROPERTY

A. Protection: The Contractor shall take all reasonable precautions to protect existing property, systems and equipment. At completion of Work, all areas of the site damaged or otherwise adversely affected by the work under this Contract shall be repaired, replaced, or otherwise returned to their original conditions without cost to the Owner.

1.11 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.
   1. Substitutions for Convenience (as defined in this Section): Will only be considered in the Bidding Phase only in accordance with the Instructions to Bidders. Substitutions for convenience must be submitted electronically via www.centerlinebidconnect.com

B. Related Requirements:
   1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
   2. Divisions 02 through 33 Sections for specific requirements and limitations for substitutions.

1.03 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.04 ACTION SUBMITTALS

A. Substitution Requests: Submit electronic copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Substitution Request Form (During Construction): Submit electronically via www.centerline.co
   2. Substitution Request Form (Bidding Phase): Submit electronically via www.centerlinebidconnect.com. Submit during the bidding phase for consideration of substitutions prior to submittal of bids in accordance with the Instructions to Bidders.
   3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
      b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
      d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
      e. Samples, where applicable or requested.
      f. Certificates and qualification data, where applicable or requested.
      g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.

h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

4. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation. Within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
   a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
   b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.05 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.06 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
   1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
      a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
      b. Requested substitution provides sustainable design characteristics that specified product provided.
      c. Substitution request is fully documented and properly submitted.
      d. Requested substitution will not adversely affect Contractor's construction schedule.
      e. Requested substitution has received necessary approvals of authorities having jurisdiction.
      f. Requested substitution is compatible with other portions of the Work.
      g. Requested substitution has been coordinated with other portions of the Work.
      h. Requested substitution provides specified warranty.

i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Submit requests for substitution for convenience electronically.
   1. General: Architect will consider requests for substitution if received within 7 working days of the bid opening date, as per Instructions to Bidders. Requests received after that time will not be considered by Architect.
   2. Conditions for Consideration: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
      a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
      b. Requested substitution does not require extensive revisions to the Contract Documents.
      c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
      d. Substitution request is fully documented and properly submitted.
      e. Requested substitution will not adversely affect Contractor's construction schedule.
      f. Requested substitution has received necessary approvals of authorities having jurisdiction.
      g. Requested substitution is compatible with other portions of the Work.
      h. Requested substitution has been coordinated with other portions of the Work.
      i. Requested substitution provides specified warranty.
      j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:
   1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.03 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, via www.centerline.co.

1.04 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
   2. Within time specified in Proposal Request, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include costs of labor and supervision directly attributable to the change.
      d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
      e. Proposal Request Form: Provide information on Facility Planning & Control Change Order forms, including the Change Order Summary, Change Order Breakdown, Change Order Breakdown Comment Sheet, and Change Order Unit Price Breakdown, as applicable to the proposal request.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
   1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
   2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   3. Indicate delivery charges, equipment rental, and amounts of trade discounts.
   4. Include costs of labor and supervision directly attributable to the change.
   5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Provide information on Facility Planning & Control Change Order forms, including the Change Order Summary, Change Order Breakdown, Change Order Breakdown Comment Sheet, and Change Order Unit Price Breakdown, as applicable to the proposal request.

1.05 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.06 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
   1. Throughout the duration of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the contract, within 10 days from the date materials are procured, equipment is utilized, and man hours are performed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 2900 - PAYMENT PROCEDURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:
   1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   2. Section 013000 "Submittal Procedures" for administrative requirements governing the preparation and submittal of submittal schedule.
   3. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.03 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.04 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
   1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with continuation sheets.
      b. Submittal schedule.
      c. Items required to be indicated as separate activities in Contractor's construction schedule.
   2. Submit the initial schedule of values to Architect and Owner at the Pre-Construction Conference, on the Schedule of Values form provided as part of these Specifications.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
   1. Identification: Include the following Project identification on the schedule of values:
      a. Project name and location.
      b. Name of Architect.
      c. State project number.
      d. Contractor's name and address.
      e. Date of submittal.
   2. Arrange schedule of values consistent with format of Schedule of Values included as part of these Specifications.
   3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
   4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
   5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
      a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
8. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

C. A Schedule of Values shall be submitted by the Contractor in Excel format along with the Pay Application each month.

1.05 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: Progress payments shall be submitted to Architect seven days before the regularly scheduled monthly progress meeting. The period covered by each Application for Payment is one month, ending on the last day of the month.
1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
5. A Schedule of Values shall be submitted by the Contractor in Excel format along with the Pay Application each month.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:
    a. Materials previously stored and included in previous Applications for Payment.
    b. Work completed for this Application utilizing previously stored materials.
    c. Additional materials stored with this Application.
    d. Total materials remaining stored, including materials with this Application.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
   1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
   1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
   2. When an application shows completion of an item, submit conditional final or full waivers.
   3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
   4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors.
   2. Schedule of values, both hard copy and in Excel format.
   3. Contractor's construction schedule (preliminary if not final).
   4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
   5. Products list (preliminary if not final).
   6. Schedule of unit prices.
   7. Submittal schedule (preliminary if not final).
   8. List of Contractor's staff assignments.
   9. List of Contractor's principal consultants.
   10. Copies of building permits.
   11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
   12. Initial progress report.
   13. Report of preconstruction conference.
   14. Certificates of insurance and insurance policies.
   15. Performance and payment bonds.
   16. Data needed to acquire Owner's insurance.
   17. Fixed job site overhead cost itemized as per 7.1.4 of the AIA A201 – 2007, General Conditions of the Contract for Construction as amended herein

I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
   1. Evidence of completion of Project closeout requirements.
   2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
   3. Updated final statement, accounting for final changes to the Contract Sum.
   4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
   5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."

6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

PART 2 EXECUTION (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 3000 - SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:
   1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
   2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.

1.03 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Centerline: Centerline is a web based project management system to be used on this project. All project information will be maintained on this system. Information contained on this system will be the official log of all project information. The contractor shall pay all fees associated with his access to this project management system.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

E. Bluebeam Document (BSX): A standard file format licensed by Bluebeam Software, Inc. and available for use in creating, marking up, collaborating, and sharing PDF documents. Contractor shall pay all fees for access to this program for this project.

1.04 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
   1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
   2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
   3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
      a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
   4. Format: Arrange the following information in a tabular format:
      a. Scheduled date for first submittal.
      b. Specification Section number and title.
      c. Submittal category: Action; informational.

d. Name of subcontractor.
e. Description of the Work covered.
f. Scheduled date for Architect's final release or approval.
g. Scheduled dates for installation.

1.05 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic copies in PDF format of the Contract Drawings will be provided one time by Architect for Contractor's use in preparing submittals.
1. Architect will furnish Contractor digital AutoCAD drawing files, indicated below, for use in preparing Shop Drawings and Project record drawings within 21 days of receiving request for files.
a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
b. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD 2010 or higher.
c. Contractor shall execute a data licensing agreement in the form of the Architect's CAD Release Letter included at the end of this Section.
d. The following AutoCAD files only will by furnished for each appropriate discipline:
1) Overall floor plans.
2) Overall reflected ceiling plans.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
a. Architect reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned Architect before being returned to Contractor.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., SSH-ABRC-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., SSH-ABRC-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of Architect.
   e. Name of Contractor.
   f. Name of firm or entity that prepared submittal.
   g. Names of subcontractor, manufacturer, and supplier.
   h. Category and type of submittal.
   i. Submittal purpose and description.
   j. Specification Section number and title.
   k. Specification paragraph number or drawing designation and generic name for each of multiple items.
   l. Drawing number and detail references, as appropriate.
   m. Location(s) where product is to be installed, as appropriate.
   n. Related physical samples submitted directly.
   o. Indication of full or partial submittal.
   p. Transmittal number, numbered consecutively.
   q. Submittal and transmittal distribution record.
   r. Other necessary identification.
   s. Remarks.
5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

E. Options: Identify options requiring selection by Architect.

F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 PRODUCTS

2.01 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   1. Post electronic submittals as PDF electronic files directly to the Project on www.centerline.co.
      a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
   2. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
   3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
      a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
      b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each submittal to show which products and options are applicable.
   3. Include the following information, as applicable:
      a. Manufacturer's catalog cuts.
      b. Manufacturer's product specifications.
      c. Full range of color charts.
      d. Statement of compliance with specified referenced standards.
      e. Testing by recognized testing agency.
      f. Application of testing agency labels and seals.
      g. Notation of coordination requirements.
      h. Availability and delivery time information.
   4. For equipment, include the following in addition to the above, as applicable:
      a. Wiring diagrams showing factory-installed wiring.
      b. Printed performance curves.
      c. Operational range diagrams.
      d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
   5. Submit Product Data before or concurrent with Samples.
   6. Submit Product Data in the following format:
      a. PDF electronic file.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Identification of products.
      b. Schedules.
      c. Compliance with specified standards.
      d. Notation of coordination requirements.
      e. Notation of dimensions established by field measurement.
      f. Relationship and attachment to adjoining construction clearly indicated.
      g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
3. Submit Shop Drawings in the following format:
    a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
    a. Generic description of Sample.
    b. Product name and name of manufacturer.
    c. Sample source.
    d. Number and title of applicable Specification Section.
    e. Specification paragraph number and generic name of each item.
3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    a. Number of Samples: Submit sets of Samples. Architect will retain two Sample sets; remainder will be returned.
        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

5. Submit product schedule in the following format:
    a. PDF electronic file.

F. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

G. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017800 "Closeout Submittals."

J. Maintenance Data: Comply with requirements specified in Section 017800 "Closeout Submittals."

K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

M. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

R. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
    1. Name of evaluation organization.
    2. Date of evaluation.
    3. Time period when report is in effect.
    4. Product and manufacturers' names.
    5. Description of product.
    6. Test procedures and results.
    7. Limitations of use.

T. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

U. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

V. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

W. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.02 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file signed and sealed by a licensed, (in the state of the project location), responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 EXECUTION

3.01 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017800 "Closeout Submittals."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents. Submittals shall be marked up using Bluebeam software: Contractor shall use BLUE color mark ups with Arial 10 point text, Architect shall use RED, Civil - TEAL, Structural - GREEN, Mechanical & Plumbing - PLUM, Electrical - ORANGE, Security - BURNT ORANGE, Landscape - MAGENTA, Audio-Video Consultant - FOREST GREEN and Special Systems - LIGHT PURPLE.

3.02 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
   1. Final Unrestricted Release: When the Architect marks a submittal "Approved," or "No Exceptions Taken", the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.

2. Final-But-Restricted Release: When the Architect marks a submittal "Approved as Noted," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
3. Returned for Resubmittal: When the Architect marks a submittal “Revise and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
   a. Do not use, or allow others to use, submittals marked "Revise and Resubmit" or “Rejected” at the Project Site or elsewhere where Work is in progress.
4. Other Action: Where a submittal is for information or record purposes or special processing or other activity, the Architect will return the submittal marked "Action Not Required."

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

E. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

3.03 ELECTRONIC FILE AGREEMENT LETTER:

A. Submit the text below in letter format, on contractor letterhead, signed by a authorized signatory of the contractor, to the project Architect to request electronic file documents.

Date

Grace Hebert Curtis Architects, LLC

501 Government St., Suite 200

Baton Rouge, LA 70802

Re: Specialty Surgery Hospital

Dear Project Architect,

We are requesting that Grace Hebert Curtis Architects, LLC, (herein after “GHC”), provide electronic files, floor plans and reflected ceiling plans only), for our convenience and use for the above referenced project, subject to the following terms and conditions:

GHC’s electronic files are compatible with AUTOCAD 2014 GHC makes no representation as to the compatibility of these files with specific hardware or software beyond the specified release of the referenced specifications.

Data contained on these electronic files is part of GHC’s instruments of service and shall not be used by us or anyone else receiving this data through or from us for any purpose. Use by us or by others will be at our sole risk and without liability or legal exposure to GHC. We agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against GHC, its officers, directors, employees, agents or subconsultants which may arise out of or in connection with your use of the electronic files.

Furthermore, we shall, to the fullest extent permitted by law, indemnify and hold harmless GHC from all claims, damages, losses and expenses, including attorney’s fees arising out of or resulting from our use of these electronic files.

These electronic files are not contract documents. Significant difference may exist between these electronic files and corresponding hard copy contract documents due to addendum, change orders or other revisions. GHC makes no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed documents prepared by GHC and electronic files, the signed

contract document shall govern. We shall be responsible for determining if any conflict exists. By our use of these electronic files, we are not relieved of our duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate our work with that of other contractors for the project.

Because of the potential that the information presented on the electronic files can be modified, unintentionally or otherwise, GHC reserves the right to remove all indicia of its ownership and/or involvement for each electronic display.

Under no circumstances shall delivery of the electronic files for use by us be deemed a sale by GHC, and GHC makes no warranties, either expressed or implied, of merchantability and fitness for any particular purpose. In no event shall GHC be liable for any loss of profit or any consequential damages. These documents may not be distributed to any other party without the express written consent of GHC.

This request is allowed for floor plans and reflected ceiling plans only.

By signing this document, I agree to the terms above.

_____ _____

Signature Date

END OF SECTION

SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General coordination procedures.
   2. Requests for Information (RFIs).
   3. Project meetings.

B. Contractor shall prepare and submit any and all items electronically via www.centerline.co. Email shall not be considered the means of notification of any item to the Architect, all contract communication shall be thru Centerline.

C. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

D. Related Requirements:
   1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
   2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.03 DEFINITIONS

A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.04 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, and telephone number of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
   1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.05 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.06 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in Section 013113 "Project Coordination Drawings", and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1.07 KEY PERSONNEL

A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.08 REQUESTS FOR INFORMATION (RFIS)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI electronically via www.centerline.co.
1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
2. Project number.

3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow fourteen (14) working days for Architect's response for each RFI. RFIs received by after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.
2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modification Procedures."
    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

D. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.09 PROJECT MEETINGS

A. General: Architect will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
   2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
   3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
   1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Contractor to provide the following items to Owner at Preconstruction Conference:
      a. General Contractor Project Team.
      b. Licenses, Insurance and Bonds
      c. List of Sub-contractors and major suppliers.
      d. Cost breakdown (Schedule of Values), shall be in standard Construction Specifications Institute format
      e. Construction Schedule
      f. Fixed jobsite overhead cost itemized with documentation to support daily rates.
      g. Bond Premium Rate with supporting information from the General Contractor's carrier.
      h. Labor Burden by trade for both Subcontractors and General Contractor.
      i. Internal Rate Charges for all significant company owned equipment.
   3. Agenda: Discuss items of significance that could affect progress, including the following:
      a. Tentative construction schedule.
      b. Phasing.
      c. Critical work sequencing and long-lead items.
      d. Designation of key personnel and their duties.
      e. Lines of communications.
      f. Procedures for processing field decisions and Change Orders.
      g. Procedures for RFIs.
      h. Procedures for testing and inspecting.
      i. Procedures for processing Applications for Payment.
      j. Distribution of the Contract Documents.
      k. Submittal procedures.
      l. Preparation of record documents.
      m. Use of the premises.
      n. Work restrictions.
      o. Working hours.
      p. Responsibility for temporary facilities and controls.
      q. Procedures for moisture and mold control.
      r. Procedures for disruptions and shutdowns.
      s. Construction waste management and recycling.
      t. Parking availability.
      u. Office, work, and storage areas.
      v. Equipment deliveries and priorities.
      w. First aid.
      x. Security.

y. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Project Closeout Conference: Architect will schedule and conduct a Project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
   1. Conduct the conference to review requirements and responsibilities related to Project closeout.
   2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
   3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
      a. Preparation of record documents.
      b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
      c. Submittal of written warranties.
      d. Requirements for preparing operations and maintenance data.
      e. Requirements for delivery of material samples, attic stock, and spare parts.
      f. Requirements for demonstration and training.
      g. Preparation of Contractor's punch list.
      h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
      i. Submittal procedures.
      j. Coordination of separate contracts.
      k. Owner's partial occupancy requirements.
      l. Installation of Owner's furniture, fixtures, and equipment.
      m. Responsibility for removing temporary facilities and controls.
   4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

D. Progress Meetings: Architect will conduct progress meetings once a month.
   1. Date of monthly progress meetings will be coordinated and determined at Pre-Construction Conference.
   2. Attendees: In addition to representatives of Owner, Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
   3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
      a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
         1) Review schedule for next period.
      b. Review present and future needs of each entity present, including the following:
         1) Interface requirements.
         2) Sequence of operations.
         3) Status of submittals.
         4) Deliveries.
         5) Off-site fabrication.

6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Progress cleaning.
10) Quality and work standards.
11) Status of correction of deficient items.
12) Field observations.
13) Status of RFIs.
14) Status of proposal requests.
15) Pending changes.
16) Status of Change Orders.
17) Pending claims and disputes.
18) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
   a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Startup construction schedule.
   2. Contractor's construction schedule.
   3. Construction schedule updating reports.
   4. Daily construction reports.
   5. Material location reports.
   6. Site condition reports.
   7. Special reports.

B. Related Requirements:
   1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
   2. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.03 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
   1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.
   1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
   2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
   3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.04 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:
   1. PDF electronic file.

B. Startup construction schedule.
   1. Approval of cost-loaded start-up construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
   1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
   1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
   2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
   3. Total Float Report: List of all activities sorted in ascending order of total float.
   4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at monthly intervals.

I. Field Condition Reports: Submit at time of discovery of differing conditions.

J. Special Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

1.05 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
   1. Review software limitations and content and format for reports.
   2. Verify availability of qualified personnel needed to develop and update schedule.
   3. Discuss constraints, including work stages and interim milestones.
   4. Review submittal requirements and procedures including review time required for review of submittals and resubmittals.
   5. Review requirements for tests and inspections by independent testing and inspecting agencies.
   6. Review time required for completion and startup procedures, including commissioning activities.
   7. Review and finalize list of construction activities to be included in schedule.
   8. Review procedures for updating schedule.

1.06 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from entities involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 PRODUCTS

2.01 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
   1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
   1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
   2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 30 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
   3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
   4. Startup and Testing Time: Include not less than 15 days for startup and testing.
   5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
   6. Punch List and Final Completion: Include not more than 30 days for punch list and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
   1. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   2. Work Restrictions: Show the effect of the following items on the schedule:
      a. Uninterruptible services.
      b. Partial occupancy before Substantial Completion.
      c. Use of premises restrictions.
      d. Provisions for future construction.
      e. Seasonal variations.
      f. Environmental control.
   3. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
      a. Subcontract awards.
      b. Submittals.
      c. Purchases.
      d. Mockups.
      e. Fabrication.
      f. Sample testing.
      g. Deliveries.
      h. Installation.
      i. Tests and inspections.
      j. Adjusting.

k. Curing.
l. Startup and placement into final use and operation.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion , and the following interim milestones:
1. Temporary enclosure and space conditioning.

E. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
1. Refer to Section 012900 "Payment Procedures" for cost reporting and payment procedures.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.02 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Start-up Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's construction schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.
a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to correlate with Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the start-up network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
a. Preparation and processing of submittals.
b. Mobilization and demobilization.

c. Purchase of materials.
d. Delivery.
e. Fabrication.
f. Utility interruptions.
g. Installation.
h. Work by Owner that may affect or be affected by Contractor's activities.
i. Testing.
j. Punch list and final completion.
k. Activities occurring following final completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
   a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under principal subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
   a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
   b. Total cost assigned to activities shall equal the total Contract Sum.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Principal events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
    a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.03 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site: Daily reports are to be submitted electronically via www.centerline.co.
    1. List of subcontractors at Project site.
    2. List of separate contractors at Project site.
    3. Approximate count of personnel at Project site.
    4. Equipment at Project site.
    5. Material deliveries.
    6. High and low temperatures and general weather conditions, including presence of rain or snow.
    7. Accidents.
    8. Meetings and significant decisions.
    9. Unusual events (refer to special reports).
    10. Stoppages, delays, shortages, and losses.
    11. Meter readings and similar recordings.
    12. Emergency procedures.
    13. Orders and requests of authorities having jurisdiction.
    14. Change Orders received and implemented.
    15. Construction Change Directives received and implemented.
    16. Services connected and disconnected.
    17. Equipment or system tests and startups.
    18. Partial completions and occupancies.
    19. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
    1. Material stored prior to previous report and remaining in storage.
    2. Material stored prior to previous report and since removed from storage and installed.
    3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.04 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report.

List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 EXECUTION

3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
   1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
   2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
   2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
   3. As the Work progresses, indicate final completion percentage for each activity.

C. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
   1. Post copies in Project meeting rooms and temporary field offices.
   2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities

END OF SECTION

SECTION 01 3233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Preconstruction photographs.
   2. Periodic construction photographs.
   3. Final Completion construction photographs.

B. Related Requirements:
   1. Section 013000 "Submittal Procedures" for submitting photographic documentation.
   2. Section 017700 "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.

1.03 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files weekly within three days of taking photographs, via www.centerline.co.
   1. Digital Camera: Minimum sensor resolution of 10 megapixels.
   2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
   3. Identification: Provide the following information with each image description in file metadata tag:
   4. Name of Project.
   5. Name and contact information for photographer.
   6. Name of Architect.
   7. Name of Contractor.
   8. Date photograph was taken.
   9. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
   10. Unique sequential identifier keyed to accompanying key plan.

PART 2 PRODUCTS

2.01 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 10 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

PART 3 EXECUTION

3.01 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
   1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
   1. Date and Time: Include date and time in file name for each image.
   2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.

C. Preconstruction Photographs: Before commencement of demolition, take extensive photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
   1. Flag construction limits before taking construction photographs.
   2. Take photographs to show existing conditions adjacent to property before starting the Work.
   3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Periodic Construction Photographs: Take photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

E. Architect--Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.

F. Final Completion Construction Photographs: Take color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.
   1. Do not include date stamp.

G. Additional Photographs: Architect may request photographs in addition to periodic photographs specified.
   1. Three days' notice will be given, where feasible.
   2. In emergency situations, take additional photographs within 24 hours of request.
   3. Circumstances that could require additional photographs include, but are not limited to, the following:
   4. Special events planned at Project site.
   5. Immediate follow-up when on-site events result in construction damage or losses.
   6. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
   7. Substantial Completion of a major phase or component of the Work.
   8. Extra record photographs at time of final acceptance.
   9. Owner's request for special publicity photographs.

END OF SECTION

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. The Owner shall engage and pay for the services of an independent testing laboratory to perform inspections and tests of materials and construction as defined in the General Conditions and indicated in these specification, except that in the event of a test failure the Contractor shall pay for any retesting. The Contractor is to select the testing lab and pay for all concrete design mix testing.

C. Related Requirements:
   1. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.03 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project;

being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.04 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.05 ACTION SUBMITTALS

A. Shop Drawings: For mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
   1. Indicate manufacturer and model number of individual components.
   2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.06 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
   1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
   2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.
   4. Identification of applicable standards.
   5. Identification of test and inspection methods.
   6. Number of tests and inspections required.
   7. Time schedule or time span for tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality-control service.

1.07 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
   1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
   2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
   3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.08 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   7. Identification of product and Specification Section.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
   10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
   11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting and re-inspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of technical representative making report.
   2. Statement on condition of substrates and their acceptability for installation of product.
   3. Statement that products at Project site comply with requirements.
   4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
   5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   6. Statement whether conditions, products, and installation will affect warranty.
   7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of factory-authorized service representative making report.
   2. Statement that equipment complies with requirements.
   3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   4. Statement whether conditions, products, and installation will affect warranty.
   5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.09 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
   1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor responsibilities include the following:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
      c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
      d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
      e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
      f. When testing is complete, remove test specimens, assemblies and mockups; do not reuse products on Project.
   2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
   2. Notify Architect seven (7) days in advance of dates and times when mockups will be constructed.
   3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
   4. Demonstrate the proposed range of aesthetic effects and workmanship.
   5. Obtain Architect’s approval of mockups before starting work, fabrication, or construction.
      a. Allow seven (7) days for initial review and each re-review of each mockup.
   6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   7. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   2. Payment for these services will be made by Owner via separate Contract.
   3. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
   1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in pre-installation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Commissioning Authority and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
   1. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
   1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
   2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
   3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority, with copy to Contractor and to authorities having jurisdiction.
   4. Submitting a final report of special tests and inspections at Substantial Completion which includes a list of unresolved deficiencies.
   5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
   6. Retesting and reinspecting corrected work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.
   3. Date test or inspection results were transmitted to Architect.
   4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's reference during normal working hours.

3.02 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:
   1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.03 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, occupants of Project site, testing agencies, and authorities having jurisdiction.

B. Sewer Service: The Contractor pay water service use charges for sewer service used by all entities for construction operations, including all deposit and tie-in fees.

C. Water Service: The Contractor will pay water service use charges for water used by all entities for construction operations, including all deposit and tie-in fees.

D. Electric Power Service: The Contractor will pay electric power service use charges for electricity used by all entities for construction operations, including all deposits and tie-in fees.

1.04 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.Submit for local permits as required by the authority having jurisdiction.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
   1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
   2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
   3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

1.05 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in ICC/ANSI A117.1. Provide temporary egress at locations as indicated on Drawings.

1.06 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 PRODUCTS

2.01 MATERIALS

A. Chain-Link Construction Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.

B. Construction Privacy Screening: Knitted closed polyethylene mesh. Opacity 80% to 90%. Reinforced hems on all sides with grommets spaced at 24" o.c. Privacy screening to be custom printed with graphics for this project as provided by the Owner at the Pre-Construction Conference.

2.02 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate the needs of construction personnel office activities and to accommodate project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
   1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
   2. Conference room of sufficient size to accommodate meetings of 20 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
   3. Drinking water and private toilet.
   4. Coffee machine and supplies.
   5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
   6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
   1. Store combustible materials apart from building.

2.03 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
   3. Permanent HVAC System: Owner authorizes use of permanent HVAC system for temporary use during construction, therefore provide filter with MERV of 13 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures."

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
   1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.02 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.
   1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
   1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
   1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
   1. Install electric power service overhead, unless otherwise indicated.
   2. Connect temporary service to Owner's existing power source, as directed by Owner.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
   2. Install lighting for Project identification sign.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install two telephone line for each field office.
   1. At each telephone, post a list of important telephone numbers.
      a. Police and fire departments.
      b. Ambulance service.
      c. Contractor's home office.
      d. Contractor's emergency after-hours telephone number.
      e. Architect's office.
      f. Engineers' offices.
      g. Owner's office.
      h. Principal subcontractors' field and home offices.

2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.03 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
   1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
   2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Provide temporary parking areas for construction personnel within limits of project site. Coordinate locations with Owner's representative to minimize interference of Owner's use of the Project site.

D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
   1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
   2. Remove snow and ice as required to minimize accumulations

E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
   1. Identification Signs: Provide Project identification signs. Location of signs to be coordinated at Pre-Construction Conference.
   2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
      a. Provide temporary, directional signs for construction personnel and visitors.
   3. Maintain and touchup signs so they are legible at all times.

F. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
   1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.04 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
   1. Comply with work restrictions specified in Section 011000 "Summary."

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
   1. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings or if not provided the requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
   1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.

2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations or as indicated on Drawings.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated in drawings and as required by authorities having jurisdiction.

J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

K. Temporary Partitions: Provide floor-to-deck dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
1. Construct partitions with six (6) inch metal studs at 12" o.c., full batt insulation and gypsum wallboard with joints taped on each side. Metal stud deflection design to be responsibility of metal stud supplier professional engineer licensed in the State of Louisiana.
2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
3. Insulate partitions to control noise transmission to occupied areas.
4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
5. Protect air-handling equipment.
6. Provide walk-off mats at each entrance through temporary partition.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.05 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Area: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Area: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace, or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Area of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.06 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
   2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
   3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:
   1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.03 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.04 ACTION SUBMITTALS

A. Comparable product requests or substitutions for the Contractor’s convenience will not be considered after award of bid unless otherwise indicated.

B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
   2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
      a. Form of Approval: As specified in Section 013000 "Submittal Procedures."
      b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013000 "Submittal Procedures." Show compliance with requirements.

1.05 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
   1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
   2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:
   1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:
   1. Store products to allow for inspection and measurement of quantity or counting of units.
   2. Store materials in a manner that will not endanger Project structure.
   3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
   5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   6. Protect stored products from damage and liquids from freezing.
   7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.07 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
   1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
   2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
   3. See Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 PRODUCTS

2.01 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Architect will make selection.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
   6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
      a. Products specified with “or equal” provisions will only be considered after award of bid at the discretion of the Architect. Refer to Section 012500 “Substitution Procedures” for requests for “or equal” products.

B. Product Selection Procedures:
   1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   3. Products:
      a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered after award of bid unless otherwise indicated.
      b. Non-restricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
   4. Manufacturers:
      a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
      b. Non-restricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
      c. Comparable products or substitutions for Contractor’s convenience will not be considered after award of bid unless otherwise indicated.
   5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable

Products" Article for consideration of an unnamed product by one of the other named manufacturers.

a. Comparable products or substitutions for Contractor’s convenience will not be considered after award of bid.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.02 COMPARABLE PRODUCTS

A. Comparable products or substitutions for Contractor’s convenience will not be considered after award of bid unless otherwise indicated.

B. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 7300 - EXECUTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
   3. Installation of the Work.
   4. Cutting and patching.
   5. Progress cleaning.
   6. Starting and adjusting.
   7. Protection of installed construction.
   8. Correction of the Work.

B. Related Requirements:
   1. Section 011000 "Summary" for limits on use of Project site.
   2. Section 013000 "Submittal Procedures" for submitting surveys.
   3. Section 078400 "Firestopping" for patching penetrations in fire-rated construction.

1.03 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.04 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
   1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
   2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
      a. Primary operational systems and equipment.
      b. Fire separation assemblies.
      c. Air or smoke barriers.
      d. Fire-suppression systems.
      e. Mechanical systems piping and ducts.
      f. Control systems.
      g. Communication systems.
      h. Fire-detection and -alarm systems.
      i. Conveying systems.
      j. Electrical wiring systems.
      k. Operating systems of special construction.
   3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or

decreased operational life or safety. Other construction elements include but are not limited to the following:

a. Water, moisture, or vapor barriers.
b. Membranes and flashings.
c. Sprayed fire-resistive material.
d. Equipment supports.
e. Piping, ductwork, vessels, and equipment.
f. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 PRODUCTS

2.01 MATERIALS

A. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Existing Conditions: The existence and location of utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of utilities, mechanical and electrical systems, and other construction affecting the Work.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.03 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
   1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
   2. Establish limits on use of Project site.
   3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   4. Inform installers of lines and levels to which they must comply.
   5. Check the location, level and plumb, of every major element as the Work progresses.
   6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
   7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.04 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
   2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework. Survey shall indicate all information as required by local, state or federal authorities for finish floor grades to meet local requirements.

3.05 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.06 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
   5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
   6. Proceed with patching after construction operations requiring cutting are complete.

F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
      a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
      b. Restore damaged pipe covering to its original condition.
   3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
      a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
   4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
   5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.07 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
      a. Use containers intended for holding waste materials of type to be stored.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.08 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.09 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 01 7419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for the following:
   1. Recycling nonhazardous construction waste.
   2. Disposing of nonhazardous demolition and construction waste.

B. Related Sections include the following:
   1. Division 1 Section "Temporary Facilities and Controls" for environmental-protection measures during construction, and location of waste containers at Project site.

1.03 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.04 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:
   1. Construction Waste:
      a. Metals.
      b. Insulation.
      c. Carpet.
      d. Gypsum board.
      e. Piping.
      f. Electrical conduit.
      g. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
         1) Paper.
         2) Cardboard.
         3) Boxes.
         4) Plastic sheet and film.
         5) Polystyrene packaging.
         6) Wood crates.
         7) Plastic pails.

1.05 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for the Notice to Proceed describing waste management efforts in accordance with the specified requirements.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
   1. Review and discuss waste management plan including responsibilities of waste management coordinator.
   2. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
   3. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
   4. Review waste management requirements for each trade.

1.07 WASTE MANAGEMENT PLAN

A. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
   1. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   2. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
   3. Store components off the ground and protect from the weather.
   4. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.02 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   2. Polystyrene Packaging: Separate and bag materials.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

3.03 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION

SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.
   5. Repair of the Work.
   6. Correction period inspection.

B. Related Requirements:
   1. Section 013233 "Photographic Documentation" for submitting final completion construction photographic documentation.
   2. Section 017300 "Execution" for progress cleaning of Project site.
   3. Section 017800 "Closeout Submittals" for submitting record Drawings, record Specifications, record Product Data and operation and maintenance manual requirements.
   4. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.03 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.04 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.06 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

3. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.07 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.08 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Punch list is to be generated with Bluebeam Software, using the Markups List to indicate items on record floor plans.
   1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
   2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
   3. Include the following information at the top of each page:
      a. Project name.
      b. Date.
      c. Name of Architect.
      d. Name of Contractor.
      e. Page number.
   4. Submit list of incomplete items in the following format:
      a. PDF electronic file, as generated using Bluebeam Software. Architect will return annotated file.

1.09 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
   1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
   4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

1.10 CORRECTION PERIOD INSPECTION

A. No later than eleven (11) months following the date of substantial completion a Contractor’s one-year correction period inspection of the facility shall be conducted by the Contractor for the purpose of reviewing Work believed by the Owner not to be in accordance with the

requirements of the Contract Documents. The Contactor, an Owner's representative and the Architect if requested by the Owner shall attend the inspection. The Contractor shall correct to the satisfaction of the Owner all work found to be deficient. Contractor's obligations under this paragraph are in addition to any other obligation, warranty and guaranties furnished in the Contract Documents by the Contractor, the installer or the manufacturer of products, equipment or systems.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 EXECUTION

3.01 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Remove snow and ice to provide safe access to building.
    f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    h. Sweep concrete floors broom clean in unoccupied spaces.
    i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
    j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
    k. Remove labels that are not permanent.
    l. Wipe surfaces of mechanical and electrical equipment , elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    p. Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.

q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
r. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Division 01 Section "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.02 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
   a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

SECTION 01 7800 - CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Submittal Procedures: Submittals, shop drawings, product data, and samples.

B. Individual Product Sections: Specific requirements for operation and maintenance data.

C. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
   2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   4. Submit three sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications:

1. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
    a. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
    b. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
    c. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
    d. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
    e. Note related Change Orders and record Drawings where applicable.
2. Format: Submit record Specifications as paper copy.

F. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding archive photographic documentation.
2. Content: Types of items requiring marking include, but are not limited to, the following:
    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations below first floor.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

F. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Include test and balancing reports.

L. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

D. Prepare data in the form of an instructional manual.

E. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

F. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

G. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

H. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

I. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

J. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.

K. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

L. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.

M. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for equipment and systems.
      f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
   3. Part 3: Project documents and certificates, including the following:
      a. Shop drawings and product data.

N. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

O. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for

items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

3.07 FINAL CLEANING

A. General: General cleaning during construction is required by the General Conditions and included in Section "Temporary Facilities".

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

1. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface, or final grade and dress with topsoil, sodding, or seeding if required elsewhere in the Specifications.

C. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

END OF SECTION

SECTION 01 7900 - DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Demonstration and training video recordings.

B. Related Requirements:
   1. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.03 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
   1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For facilitator and instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.04 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
   1. Inspect and discuss locations and other facilities required for instruction.
   2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
   3. Review required content of instruction.
   4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.05 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 PRODUCTS

2.01 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections including the following:
   1. Motorized doors, including overhead coiling door.
   2. Equipment, including food service equipment and residential appliances
   3. Fire-protection systems, including fire alarm and fire-extinguishing systems.
   4. Heat generation equipment and distribution piping.
   5. Refrigeration systems and distribution piping.
   6. HVAC systems, including air-handling equipment, air distribution systems, and terminal equipment and devices.
   7. HVAC instrumentation and controls.
   8. Electrical service and distribution, including transformers, switchboards, panelboards uninterruptible power supplies, and motor controls.
   9. Packaged engine generators, including transfer switches.
   10. Lighting equipment and controls.
   11. Communication systems, including intercommunication, surveillance and voice and data equipment.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
      c. Operating standards.
      d. Regulatory requirements.
      e. Equipment function.
      f. Operating characteristics.
      g. Limiting conditions.
      h. Performance curves.
   2. Documentation: Review the following items in detail:
      a. Emergency manuals.
      b. Operations manuals.
      c. Maintenance manuals.
      d. Project record documents.
      e. Identification systems.
      f. Warranties and bonds.
      g. Maintenance service agreements and similar continuing commitments.
   3. Emergencies: Include the following, as applicable:
      a. Instructions on meaning of warnings, trouble indications, and error messages.
      b. Instructions on stopping.
      c. Shutdown instructions for each type of emergency.
      d. Operating instructions for conditions outside of normal operating limits.
      e. Sequences for electric or electronic systems.
      f. Special operating instructions and procedures.
   4. Operations: Include the following, as applicable:
      a. Startup procedures.
      b. Equipment or system break-in procedures.

c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 EXECUTION

3.01 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017800 "Closeout Submittals."

B. Set up instructional equipment at instruction location.

3.02 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
   2. Owner will furnish an instructor to describe Owner's operational philosophy.
   3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Architect, with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION

SECTION 01 8000 - ELECTRONIC REPORTING/COMMUNICATIONS

THE GENERAL CONTRACTOR SHALL BE REQUIRED TO HAVE E-MAIL AND WEB ACCESSIBILITY ON THE CONSTRUCTION SITE AND IN THE CONTRACTORS MAIN OFFICE TO ALLOW FOR ELECTRONIC COMMUNICATIONS. CONSTRUCTION SUPERINTENDENT AND THE PROJECT MANAGER SHALL HAVE INDIVIDUAL E-MAIL ADDRESSES FOR USE DURING THE CONSTRUCTION PHASE. NOTE: EMAIL IS ONLY FOR ACCESS TO CENTERLINE, E MAIL SHALL NOT BE USED IN THE EXECUTION OF THE REQUIREMENTS OF THE CONTRACT DOCUMENTS, ALL COMMUNICATION SHALL BE MAINTAINED AND DOCUMENTED THRU CENTERLINE.

1.01 THE ONLY LOGS TO BE PROVIDED, REVIEWED AND ACCEPTED AT THE CONSTRUCTION MEETINGS ARE THOSE LISTED BELOW OBTAINED FROM CENTERLINE. THE GENERAL CONTRACTOR SHALL PROVIDE THE FOLLOWING ITEMS BOTH ELECTRONICALLY AND/OR HARD COPIES AS OUTLINED BELOW:

1.02 DAILY FIELD REPORTS

A. Daily field reports shall be sent electronically the first working day after the date of the field report. File shall be sent as a PDF and shall be saved in the following method DFR_001_121423_SSH-ABRC.PDF, note the numbers in the middle are the report number and the date of the report.

1.03 WEEKLY FIELD REPORTS - FRIDAY

A. These shall be as Daily Field Reports but shall include a minimum of 10 electronic photographs. These photographs shall be of critical areas and shall be included in the same file as the Field Report.

1.04 REQUEST FOR INFORMATION

A. Request for Information shall be sent electronically to the Architect. All documents shall be sent in PDF format and saved in the following method RFI_001_SSH-ABRC.PDF. Each Request for Information shall be in one file only. Each Request for Information shall be numbered in numerical order.

1.05 APPLICATION FOR PAYMENT

A. Application for Payment shall be sent in an electronic and hard copy to the Architect. All documents shall be sent in PDF format and saved in the following method, AFP121423_SSH-ABRC.PDF. Each Application for Payment shall be in one file only.

1.06 SHOP DRAWINGS

A. Shop Drawings shall be sent electrically to the Architect via www.centerline.co, as per Section 013300. This document is also to be stored electronically at the project site for Architect and Contractor access during construction. All documents shall be sent in PDF format and saved in the following method SD_023000_01_SSH-ABRC.PDF. Each Shop Drawing shall have specification number and the submittal number for that specification section. The file above indicates specification section 023000 submittal number one. Upon completion of the project the contractor is to submit four (4) copies on CD of all Shop Drawings during the project closeout phase. These shall be in PDF format.

1.07 OPERATIONS AND MAINTENANCE MANUALS

A. Operations and Maintenance Manuals shall be sent hard copy to the Architect. After review and approval the Contractor shall submit an electronic copy to the Architect within seven (7) days of receipt of approved manuals. All documents shall be sent in PDF format and saved in the following method CM_023000_01_SSH-ABRC.PDF. Each O&M manual shall have specification number and the submittal number for that specification section. The file above indicates specification section 023000 submittal number one. Upon completion of the project the contractor is to submit four copies on CD of the entire O&M manual. These shall be in PDF format.

END OF SECTION

SECTION 03 3500 - CONCRETE FINISHING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Single application cure-seal-hardener for all new exposed concrete floors.
   2. Precautions for avoiding staining concrete before and after installation.

1.02 REFERENCES

A. ASTM International:
   1. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   2. ASTM C 779 - Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
   3. ASTM C 805 - Standard Test Method for Rebound Number of Hardened Concrete.
   4. ASTM C 1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
   5. ASTM D 3359 - Standard Test Methods for Measuring Adhesion by Tape Test.

1.03 SUBMITTALS

A. General: Submit listed submittals in accordance with conditions of the Contract and Section 01 3000 - Submittals.

B. Product Data: Submit product data, including manufacturer's data sheets, installation instructions and technical bulletins for specified products.

C. Certificates: Manufacturer's certification that the installer is acceptable.

D. Maintenance Data: Maintenance instructions, including precautions for avoiding staining after application.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Acceptable to the manufacturer.

B. Regulatory Requirements: In accordance with Section 01 4000 - Quality Control.

1.05 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 1, Section 01 6000 - Product Requirements.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

D. Handling: Protect materials from dirt, corrosion, oil, grease and other contaminants.

PART 2 PRODUCTS

2.01 MATERIAL (SC-1)

A. Curecrete Distribution, Inc.
   1. 1203 W. Spring Creek Place, Springville, UT 84663-0551; Ph. (800) 998-5664; www.ashfordformula.com
   2. Or approved equal
   3. Cure-Seal Hardener: Ashford Formula, a water-based chemically reactive penetrating sealer and hardener that seals by densifying concrete so that water molecules cannot pass through but air and water vapor can, and allows concrete to achieve full compressive strength, minimizing surface crazing and eliminating dusting.
      a. Abrasion Resistance to Revolving Disks: At least a 32.5% improvement over untreated samples when tested in accordance with ASTM C 779.
      b. Surface Adhesion: At least a 22% increase in adhesion for epoxy when tested in accordance with ASTM D 3359.

c. Hardening: As follows when tested in accordance with ASTM C 39:
d. After 7 days: An increase of at least 40% over untreated samples.
e. After 28 days: An increase of at least 38% over untreated samples.
f. Coefficient of Friction: 0.86 dry, 0.69 wet when tested in accordance with ASTM C 1028.
g. Rebound Number: An increase of at least 13.3% over untreated samples when tested in accordance with ASTM C 805.
h. Light Exposure Degradation: No evidence of adverse effects on treated samples when tested in accordance with ASTM G 23.

2.02 PRODUCT SUBSTITUTIONS

A. Substitutions: Substitutions in accordance with Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.02 EXAMINATION

A. Do not begin installation until substrates have been properly prepared and are suitable for application of product.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.03 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Do not use frozen material. Thaw and agitate prior to use.

D. If construction equipment must be used for application, diaper all components that might drip oil, hydraulic fluid or other liquids.

3.04 INSTALLATION

A. New Concrete: Apply cure-seal-hardener to new concrete as soon as the concrete is firm enough to work on after troweling; with colored concrete, wait a minimum of 30 days before application.
1. Spray on at rate of 200 ft2/gal.
2. Keep surface wet with cure-seal-hardener for a minimum soak-in period of 30 minutes without allowing it to dry out or become slippery. In hot weather, slipperiness may appear before the 30 minute time period has elapsed. If that occurs, apply additional cure-seal-hardener as needed to keep the entire surface in a non-slippery state for the first 15 minutes. For the remaining 15 minutes, mist the surface as needed with water to keep the material in a non-slippery state. In hot weather conditions, follow manufacturer's special application procedures.
3. When the treated surface becomes slippery after this period, lightly mist with water until slipperiness disappears.
4. Wait for surface to become slippery again, and then flush entire surface with water to remove all cure-seal-hardener residue.
5. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.
6. Wet vacuum or scrubbing machines can be used in accordance with manufacturer's instructions to remove residue.

3.05 PROTECTION

A. Protect installed floors for at least 3 months until chemical reaction process is complete.
1. Do not allow traffic on floors for 3 hours after application.

2. Do not allow parking of vehicles on concrete slab.
3. If vehicles must be temporarily parked on slab, place drop cloths under vehicles during entire time parked.
4. Do not allow pipe cutting using pipe cutting machinery on concrete slabs.
5. Do not allow temporary placement and storage of steel members on concrete slabs.
6. Clean up spills immediately and spot-treat stains with degreaser or oil emulsifier.
7. Clean floor regularly in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 03 5416 - HYDRAULIC CEMENT UNDERLAYMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes hydraulic-cement-based, polymer-modified, self-leveling underlayment for application below interior floor coverings.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

B. Product Compatibility: Manufacturers of underlayment and floor-covering systems certify in writing that products are compatible.

PART 2 PRODUCTS

2.01 HYDRAULIC-CEMENT-BASED UNDERLAYMENTS

A. Underlayment: Hydraulic-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thickness of 1/4 inch (6 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Products: Subject to compliance with requirements, provide available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Ardex; K-15 Self-Leveling Underlayment Concrete.
    b. BASF Construction Chemicals, Inc; Chemrex Self-Leveling Underlayment.
    c. Bonsal American, an Oldcastle company; ProSpec Level Set 200
    d. CGM, Incorporated; PRO S.L.U. Self-Leveling Underlayment.
    e. CMP Specialty Products, Inc.; Level Finish.
    f. Dayton Superior Corporation; EconoLevel.
    g. Dependable Chemical Co., Inc.; Skimflow ES.
    h. Euclid Chemical Company (The); Super Flo-Top.
    i. L&M Construction Chemicals, Inc.; Levelex.
    j. Lambert Corporation; Lambco L-16 Self-Level.
    k. MAPEI Corporation; Novoplan Easy.
    l. Maxxon Corporation; Level-Right.
    m. Metalcrete Industries; Flowpave.
    n. RAECO, Inc.; S.L.U.
    o. Specialty Construction Brands, Inc., an H.B. Fuller company; TEC Smooth Start.
    p. Teck Specialties; Teck 2800.
    q. USG Corporation; Levelrock SLC 300.
    r. US SPEC, Division of US Mix Products Company; US SPEC Self-Leveling Underlayment.
2. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
3. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C 109/C 109M.
4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

C. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).

D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
   1. Primer shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D.
   2. Primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 EXECUTION

3.01 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.
   1. Treat nonmoving substrate cracks to prevent cracks from telegraphing (reflecting) through underlayment.
   2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Mechanically remove laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
   1. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/100 sq. m)] in 24 hours.

C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment.

3.02 APPLICATION

A. General: Mix and apply underlayment components according to manufacturer's written instructions.
   1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
   2. Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.
   3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply underlayment to produce uniform, level surface.
   1. Apply a final layer without aggregate to product surface.
   2. Feather edges to match adjacent floor elevations.

D. Cure underlayment. Prevent contamination during application and curing processes.

E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

END OF SECTION

SECTION 04 2000 - UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.

B. Mortar.

C. Reinforcement and anchorage.

D. Lintels.

E. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Loose steel lintels.

B. Section 07 2100 - Thermal Insulation: Insulated Sheathing

C. Section 07 2726 - Fluid Applied Non-Permable Air Barrier.

D. Section 07 6200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.

E. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2015b.

D. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a (Reapproved 2014).

E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.

F. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2014.

G. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2011.

H. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.

I. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.

J. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.

K. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

L. UL (FRD) - Fire Resistance Directory; current edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

B. Shop Drawings:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
   3. Control and expansion joints: Layout exact locations of control and expansion joints on a building plan. Submit detail of control & expansion joints.
   4. Head and jamb details at openings in masonry, with associated control or expansion joints.

C. Samples:

1. Weep vents

D. Manufacturer's Certificates: Certify that masonry units meet or exceed specified requirements.
   1. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
   2. Cementitious materials. Include name of manufacturer, brand name, and type.
   3. Mortar admixtures.
   4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   5. Grout mixes. Include description of type and proportions of ingredients.
   6. Reinforcing bars.
   7. Joint reinforcement.
   8. Anchors, ties, and metal accessories.

E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
   2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
   3. Include requirements of Section Cast in Place Concrete, for required mix design.

F. Cold Weather and Hot Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

G. Informational Submittals
   1. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
      a. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

1.06 QUALITY ASSURANCE

A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.
   1. Maintain one copy of each document on project site.

B. Fire Rated Assemblies: Conform to applicable code for UL Assembly No. as indicated or required.

1.07 MOCK-UP

A. Construct a masonry wall as a mock-up panel sized 8 feet (2.4 m) long by 6 feet (1.8 m) high; include mortar, accessories, structural backup, and flashings (with lap joint, corner, and end dam) in mock-up.

B. Locate where directed.

C. Build mockup of typical wall area as shown on Drawings.

D. Build mockups for each type of exposed unit masonry construction, typical exterior wall, typical interior wall typical exterior and interior walls] in sizes approximately 96 inches (2400 mm) long by 72 inches (1800 mm) high by full thickness, including face and backup wythes and accessories.
   1. Include a sealant-filled joint at least 16 inches (400 mm) long in each mockup.
   2. Include lower corner of window opening, and upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.
   3. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).

4. Include metal studs, sheathing, water-resistive barrier, sheathing joint-and-penetration treatment, air barrier, veneer anchors, flashing, cavity drainage material, and weep holes or vents in exterior masonry-veneer wall mockup.

E. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.

F. Protect accepted mockups from the elements with weather-resistant membrane.

G. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   1. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

B. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

E. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.09 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Increase extent of cover in first subparagraph below as needed to suit local climatic conditions.
   2. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
   3. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

1.10 HOT-WEATHER REQUIREMENTS:

A. Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1.11 COLD-WEATHER REQUIREMENTS:

A. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

B. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

B. Masonry Units: Obtain exposed masonry veneer units of a uniform texture and color, or a uniform blend within ranges accepted for these characteristics.

C. Cementitious Materials: Obtain cementitious ingredients of a uniform quality, including color, for each component.

2.02 MASONRY UNITS, GENERAL

A. Defective Units: Referenced standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in standard. Do not install units where defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in completed Work or will impair quality of completed masonry veneer.

B. Special Shapes: Provide shapes indicated and as follows for each form of masonry unit required:
   1. For applications requiring units of form, color, texture, and size on exposed surfaces that cannot be produced by sawing standard unit sizes.
   2. For applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
   3. For applications where stretcher units cannot accommodate special conditions including those at corners, movement joints, bond beams, sashes, and lintels.
   4. For units without cores or frogs and with exposed surfaces finished for ends of sills, caps, and similar applications that would otherwise expose unfinished unit surfaces.

2.03 CONCRETE MASONRY UNITS

A. Manufacturers:
   1. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
   2. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

B. Unit Masonry General:
   1. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
   2. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.
   3. See BIA Technical Notes 16B and NCMA TEK 7-3 for information on determining fire-resistance ratings of masonry walls.

4. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
    a. Retain subparagraph below if required by authorities having jurisdiction.
    b. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

C. Concrete Block: Comply with referenced standards and as follows:
1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depths as indicated on drawings for specific locations.
2. Special Shapes: Provide non-standard blocks configured for corners.
3. Load-Bearing Units: ASTM C90, lightweight. (Re: Structurel for locations of load bearing units).
    a. Hollow block, as indicated.
    b. Unit copmpressive strength: Provide units with minimum average net area compressive strength of 2,800 psi.
    c. Density Classification: Lightweight (less than 105 PSF)
    d. Exposed Faces: Manufacturer's standard color and texture where indicated.
4. Non-Loadbearing Units: ASTM C129.
    a. Hollow block, as indicated.
    b. Lightweight.
5. Masonry Lintels:
    a. Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.04 MORTAR MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Mortar Aggregate: ASTM C144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

D. Grout Aggregate: ASTM C404.

E. Water: Clean and potable.

F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

2.05 REINFORCEMENT AND ANCHORAGE

A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Manufacturers:

1. Dur-a Wall: a Hohmann & Barnard, Inc. company:; D/A 810, D/A 812 or D/A 817: www.h-b.com/sle.
2. WIRE-BOND: Core lock rebar positioner, www.wirebond.com.
3. Heckman Building Products, Inc.: No. 376 Rebar Positioner
4. Lock Rite: Rebar Positioner

D. Masonry Joint Reinforcement: General ladder type complying with ASTM A 951/A 951M
1. Description: Prefabricated ladder type omly welded wire units deformed continuous side rods and transverse rods.
2. Exterior walls: Hot diped galvanized steel.
3. Interior Walls: Hot-doped galvanized steel.
4. Wire size for side rods: 0.187 inch dia.;
5. Wire size for cross rods: 0.187 inch dia.
6. Spacing for Cross Rosd: Not more than 16 inches o.c.
7. Provide in heights of not less than 10 feet, with perfabricated corner and tee units.

E. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

F. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M, Class 3; 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage on each exposure.

G. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch (16 mm) of mortar coverage from masonry face.
1. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch (6.3 mm) thick, with trapezoidal wire ties 0.1875 inch (4.75 mm) thick, hot dip galvanized to ASTM A 153/A 153M, Class B.

H. Miscellaneous Anchors:
1. Anchor bolts: Headed steel bolts complying with ASTM A 307, Grade A, with ASTM A563 hex nuts and where indicated, flat washers, hot dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated or required.
a. Also refer to structural drawing and specifications.

I. Postinstalled Anchors:
1. Load Capaticy: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry, and four times the total imposed load when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
2. Material for interior locations: Carbon steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
3. Material where exterior locations and where stainless steel indicated: Alloy Group 1 stainless steel bolts, ASTM F 593 and nuts ASTM F 594.
4. Also refer to requirements of structural drawing and specifications.

2.06 FLASHINGS

A. Stainless Steel/Polymer Fabric Flashing: ASTM A240/A240M; 2 mil (.05 mm) type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric.
1. Manufacturers:
a. Hohmann & Barnard, Inc; Mighty-Flash Stainless Flashing: www.h-b.com/#sle.
b. WIRE-BOND; _____: www.wirebond.com/#sle.
c. Substitutions: See Section 01 6000 - Product Requirements.

B. Termination Bars: Stainless steel; compatible with membrane and adhesives.
1. Manufacturers:
a. Hohmann & Barnard, Inc; _____: www.h-b.com/#sle.
b. Mortar Net Solutions; Termination Bars: www.mortarnet.com/#sle.

c. York Manufacturing, Inc; Termination Bar: www.yorkmfg.com/#sle.

2.07 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vent Products: Use one of the following unless otherwise indicated:
   1. Vinyl Weep Hole/Vent: Units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
   1. Strips, full depth of cavity and 10 inches (250 mm) high, with dovetail-shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.

2.08 MASONRY CLEANERS

A. Verify acceptability of cleaner for cleaning masonry with pigmented mortar joints and for types of masonry units specified.

B. Proprietary Acidic Cleaner: Manufacturer's standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonrysurface of type indicated below without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
   1. For masonry not subject to metallic oxidation stains, use formulation consisting of a concentrated blend of surface-acting acids, chelating. and wetting agents.
   2. For dark-colored masonry not subject to metallic-oxidation stains, use formulation consisting of a liquid blend of surface-acting acids and special inhibitors.
   3. For masonry subject to metallic oxidation stains, use formulation consisting of a liquid blend of organic and inorganic acids and special inhibitors.
   4. Products: Subject to compliance with requirements, provide one of the following:
      a. 202 New Masonry Detergent; Diedrich Technologies, Inc.
      b. 200 Lime Solv; Diedrich Technologies, Inc.
      c. 202V Vana-Stop; Diedrich Technologies, Inc.
      d. Sure Klean No. 600 Detergent; ProSoCo, Inc.
      e. Sure Klean No. 101 Lime Solvent; ProSoCo, Inc.
      f. Sure Klean Vana Trol; ProSoCo, Inc.

2.09 MASONRY SEALERS

A. Verify accepatbility of sealer for compatiblity with specified masonry with masonry manfuacture prior to installation.

B. Siane-Siloxane Water Repellent: Breathable, water based silane siloxane water repellent sealer that penetrates into the surface where it chemically reacts to form a hydrophobic barrier within the pores.
   1. Manufacturers:
      a. Basis of Design Product: Armor SX5000 WB (water based) Concrete Sealer
      b. W.R. Meadows IntraGuard
      c. Seal-Krete
      d. Sika Corporation
      e. Or Approved Equal
   2. Coats: 1 Coat minimum

3. Color: Clear, transaparent, non-staining.
4. Sheen: No gloss or shine

2.10 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. Use portland cement-limemortar unless otherwise indicated.
   3. For exterior brick and block masonry, use masonry cement or mortar cement mortar.
   4. For reinforced masonry, use masonry cement or mortar cement mortar.
   5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
   1. Masonry below grade and in contact with earth: Type M.
   2. Exterior, loadbearing masonry: Type M.
   3. Exterior, non-loadbearing masonry: Type N.
   4. Exterior, thin brick thick set: Type N.
   5. Interior, loadbearing masonry: Type M.
   6. Interior, non-loadbearing masonry: Type O.

D. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with requirement on drawings.
   3. Provide grout with a slump as indicated on drawings as measured according to ASTM C 143/C 143M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.
   4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp,

unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.03 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
   2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
   3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
   3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
   5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
   7. If using Type FBS Rough brick or Type FBA brick, revise tolerance in subparagraph below to allow for variation in brick size.
   8. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
   1. If using Type FBS Rough brick or Type FBA brick, revise tolerances in five subparagraphs below to allow for variation in brick size. Consider restricting tolerances if Type FBX brick is used.
   2. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
   3. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
   4. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
   5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).[Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).]
   6. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.04 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches (100 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

3.05 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. Bed face shells in mortar and make head joints of depth equal to bed joints.
   2. Bed webs in mortar in all courses of piers, columns, and pilasters.
   3. Bed webs in mortar in grouted masonry, including starting course on footings.
   4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
   5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

E. Cut joints flush where indicated to receive waterproofing, cavity wall insulation, and air barriers, unless otherwise indicated.

F. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
   1. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes, tab-type reinforcement.
   2. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.

G. Header Bonding: Provide masonry unit headers extending not less than 3 inches (76 mm) into each wythe. Space headers not more than 8 inches (203 mm) clear horizontally and 16 inches (406 mm) clear vertically.

H. Bond wythes of composite masonry together using bonding system indicated on Drawings.

I. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.

J. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.
   1. Provide continuity with masonry-joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.

K. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown or required at juncture, bond walls together as follows:

1. Retain one of three subparagraphs below and revise to suit Project. If more than one type of bonding is required, revise subparagraphs and show locations of each on Drawings.
2. Provide individual metal ties not more than 16 inches (406 mm) o.c.
3. Provide continuity with masonry-joint reinforcement by using prefabricated T-shaped units.
4. Provide rigid metal anchors not more than 24 inches (610 mm) o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.06 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
   1. Space reinforcement not more than 16 inches (406 mm) o.c.
   2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings[in addition to continuous reinforcement].

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at corners by using prefabricated L-shaped units.

D. Retain last paragraph above or option in paragraph below.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.07 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
   1. Provide an open space not less than 1/2 inch (13 mm) wide between masonry and structural steel or concrete unless otherwise indicated. **Keep open space free of mortar and other rigid materials.**
   2. Anchor masonry with anchors embedded in masonry joints and attached to structure.As indicated on structural drawings.

3.08 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:
   1. Install preformed control-joint gaskets designed to fit standard sash block.
   2. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.

C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 9200 "Joint Sealants," but not less than 3/8 inch (10 mm).
   1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

D. If location of control and expansion joints is not indicated on drawings, place vertical joints at 30' O.C., locate contro joints at points of natural weekness of masonty work.
   1. Locate additional control joints as follows:
      a. At changes in wall height.
      b. At intersecting walls forming a T or cross shape, (but not in all wall corners).
      c. The corners of wall openings, (including window and door openings).
         1) Control joint is only required at one side of opening less than 15 feet in width unless otherwise noted.

3.09 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.
   1. See general notes on structural drawings for additional requirements.

3.10 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated. Install cavity vents at top and bottom of wall to allow for air ventilation at 16" O.C.

B. Install flashing as follows unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
   2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches (200 mm)], and through inner wythe to within 1/2 inch (13 mm) of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches (50 mm) on interior face.
   3. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches (200 mm), and 1-1/2 inches (38 mm) into the inner wythe. Form 1/4-inch (6-mm) hook in edge of flashing embedded in inner wythe.
   4. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under water-resistive barrier or air barrier, lapping at least 4 inches (100 mm). Fasten upper edge of flexible flashing to sheathing through termination bar.
   5. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
   6. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 9200 "Joint Sealants" for application indicated.
   7. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 9200 "Joint Sealants" for application indicated.
   8. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
   9. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
   10. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

E. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
   1. Use specified weep/cavity vent products to form weep holes/cavity vent holes.
   2. Space weep holes 16 inches o.c. unless otherwise indicated.

F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches (50 mm), to maintain drainage.

G. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

3.11 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 48 inches (1520 mm).

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 2000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.13 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
   6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.14 MASONRY SEALER INSTALLATION

A. Install masonry sealer in accordance with manufacturer's written instructions.

B. Surface Preparation: Protect all surrounding surfaces, including people, vehicles, property, plants and surfaces other than the masonry to which sealer is to be applied from product, splash, residue and wind drift. Surfaces must be structurally sound, clean and free from dirt, bitumen, efflorescence, oil, curing compounds, form oil, and other foreign matter. Masonry joints must be checked and repointed where necessary. All wall and roof flashings, caulking, and sealants must be in good condition and the surface fully cured and thoroughly dry before application. Apply only when surface is clean and thoroughly dried as excessive moisture inhibits penetration, reducing the service life and performance of the treatment. Moisture content must not exceed 4%. Test for compatibility prior to full application.

C. Sealer shall not be applied until masonry has been completely installed for a minimum of 30 days.

D. Sealer shall be installed only when surface and air temperature is 40° F (4 °C) and rising and 95° F (35° C) and falling during application. If freezing conditions exist before application, let surface to receive treatment thaw. Hot, windy conditions will evaporate the water carrier, reducing penetration and performance. On hot, windy days, apply early in the day and in shade, if possible.

E. Test Application: Perform a test application on the mock-up for proper penetration on each type of surface prior to full-scale application to determine suitability and final appearance. Test using the recommended application instructions. Let area dry thoroughly before inspection.

F. Do not dilute or alter product. Mix thoroughly prior to use. Dor not freeze product.

G. Protection: Protect surfaces from rainfall for six hours following treatment. If rainfall occurs and surface turns white, thoroughly flush surface and reapply product when dry.

H. Clean-up: Clean tools, equipment and overspray immediately with soap and warm water.

3.15 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 3 inches (100 mm) in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
   3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 04 2223 - ARCHITECTURAL CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Architectural ground face/ concrete masonry units.

B. Shot blasted / concrete masonry units.

C. Chisel Face, Rockface / concrete masonry units.

D. Cast Stone Sill Profiles/concrete masonry units.

E. Architectural Concrete Brick/concrete masonry units.

1.02 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 07 2000 - Board Insulation.

C. Section 07 6200 - Flashing and Sheet Metal.

1.03 REFERENCES

A. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.

B. ASTM C270 - Standard Specification for Mortar for Unit Masonry.

C. ASTM C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units

D. ASTM C1262 - Standard Test Method for Evaluating the Freeze-Thaw Durability of Dry-Cast Segmental Retaining Wall Units and Related Concrete Units

E. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry.

1.04 DEFINITIONS

A. CMU: Concrete Masonry Unit.

B. Dimensions: All unit sizes are shown as Nominal Dimensions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Scheduling: Provide to Owner or Owner’s representative a schedule and list of participants required to attend coordination and progress update meetings.
   1. Owner representative(s) for Facilities Management.
   2. General Contractor.
   3. Project Manager.
   4. Manufacturer’s Representative.
   5. Project Architect.
   6. Project Engineer.

1.06 INFORMATIONAL SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product Data: Manufacturer's product information and data sheets for each product specified in this section, including:
   1. Substrate preparation instructions and recommendations.
   2. Installation means and methods.
   3. Recommendations and requirements for proper storage and handling.

C. Shop Drawings:
   1. Submit Manufacturer’s approved shop drawings detailing the section and elevation views of each product to be installed.
   2. Coordinate with locations listed on Contract Drawings.
   3. Reinforcing: Provide drawings indicating reinforcing that complies with ACI 315 “Details and Detailing of Concrete Reinforcement”.
   4. Provide elevations indicating steel reinforcing bar placement.

5. Provide details indicating steel reinforcing bar sizes, placement, bends, and laps dimensions.

D. Warranty Information:
   1. Submit confirmation and details of manufacturer's warranty, extended warranty, and replacement policies.

E. Submit product data for each type of product specified, including certification that each type complies with specified requirements.

F. Submit sample boards, cards or charts depicting available textures and colors for each CMU.

G. Mock-Up: Construct a mock-up using the selected stone and mortar materials to illustrate the appearance of the Work specified in this section.
   1. The mock-up should be a nominal 36 inches x 36 inches (1m x 1m) minimum.
   2. Construct the mock-up using the size, color blend, texture, joint size, and installation methods specified.
   3. Architect and Owner's Representative must approve the mockup prior to commencement of Work.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver masonry materials to the site on quality wooden pallets with appropriate in-plant packaging for safe transit and handling. Store pallets in single stacks on level ground and protect from weather.

B. Deliver mortar materials in original unbroken, undamaged packages with labels intact and visible.

C. Store materials covered and off the ground until used on the Work in this section.

1.08 WARRANTY

A. Provide a copy of the project specific manufacturer's warranty which addresses the term of the warranty period (in years), the acceptable standards of production/performance and the agreed upon action for products that fail to meet the standards of production/performance within the specified warranty period.
   1. Warranty period: MANUFACTURER'S STANDARD years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers include but are not limited to the following:
   1. Basis of Design Manufacturer: Echelon, An Oldcastle Company.
   2. Or Approved Equal

B. Substitution Limitations:
   1. Submit substitution requests in accordance with provisions of Section 01 60 00.
   2. Single manufacturer will provide, from a single source, the following components:

2.02 PERFORMANCE REQUIREMENTS

A. Freeze-Thaw Resistance: Meet or exceed the requirements of ASTM C1262.

B. Fire Resistance: Rated up to (4) four hours depending on size of unit per NCMA.

C. Integral Water Repellant: Concrete Masonry Units must include an integral water repellant admixture at the time of production.

2.03 CONCRETE MASONRY UNITS

A. General / Appearance (**CMU-01 and CMU-01a**): Pre-finished, integrally colored concrete block meeting the requirements of ASTM C90. One or more faces are ground to expose the variegated colors of the natural aggregate. A factory-applied clear satin gloss acrylic enhances moisture resistance.
   1. Basis of Design Product: Trenwyth Architectural Masonry - Trendstone® concrete masonry units, from Echelon
      a. CMU-01 Sizes:

1) 4" x 8" x 16" (4F)
2) 4" x 4" x 16" (44F)
3) 4" x 12" x 24" (412F24)
4) Refer to Sheet A251 in Drawing Set for Installation Pattern

b. CMU-01a Size:
1) 4" x 8" x 16" (4F)

2. Water Repellant: Include a water repellant at the time of production.

B. General / Appearance (**CMU-02**): Natural, hand-cut and weathered stone appearance with antiqued edges and textured face. A factory-applied clear satin gloss acrylic enhances moisture resistance.
1. Basis of Design Product: Aria Slim™ Stone, from Echelon
a. Texture: Smooth
b. CMU-02 Size:
1) 4" x 4" x 36" (4F)
2. Compressive Strength: Minimum 4000 psi when tested in accordance with ASTM C1634.
3. Minimum Absorption Range by Weight: 10 lbs./cu. ft. (based on normal weight.)
4. Minimum Weight: 125 lbs./cu. ft
5. Water Repellant: Include a water repellant at the time of production.

2.04 FINISHES

A. Color:
1. Color (**CMU-01 and CMU-01a**): Midwest White
2. Color (**CMU-02**): Midnight

2.05 MORTAR

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
1. Masonry below grade and in contact with earth: Type S.
2. Exterior, loadbearing masonry: Type N.
3. Exterior, non-loadbearing masonry: Type N.
4. Interior, loadbearing masonry: Type N.
5. Interior, non-loadbearing masonry: Type O.

B. Provide pre-blended mortar that meets or exceeds the requirements of ASTM C1714/C1714M Type N.

C. Provide pre-blended mortar that meets or exceeds the requirements of ASTM C1714/C1714M Type S.

D. Mortar must include manufacturer approved compatible integral water repellent additive added to each batch in the dosage rates for mortar type specified.

2.06 MIXES

A. Portland Cement: Conforming to ASTM C150 Type I, Type II or Type III as required to achieve optimal results based on ambient project conditions.

B. Hydrated Lime: Conforming to ASTM C207, Type S.

C. Aggregates: Conforming to ASTM C144 for mortar and ASTM C404 for grout.

D. Pigments: Conforming to ASTM C979. Comply with quantity limitations in referenced standards and from the pigment manufacturer.

E. Admixtures: Comply with quantity limitation specified ASTM C1384 “Standard Specification for Admixtures for Masonry Mortars” when adding to mortar.
1. Cold Weather: Comply with ASTM C494 “Standard Specification for Chemical Admixtures for Concrete.”
2. Integral Water Repellant: Liquid polymeric, admixture that does not reduce flexural bond strength
3. Basis of Design Product: RainBloc® Water Repellent Masonry Unit admixture, manufactured by ACM Chemistries, Inc.

F. Water: Potable; Clean and drinkable.

2.07 ACCESSORIES

A. Provide coordinating accessory stones as necessary to achieve a complete installation as noted in the Contract Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that site conditions are properly prepared to receive concrete masonry units.

B. Verify that bearing elements are within tolerances conforming to the requirements of ACI 117.

C. Verify that locations of penetrations, projections and built-in items are correct and properly prepared for work specified in this section.

D. Verify concrete brick masonry units are according to project specification and meet appropriate ASTM specification requirements. Commencement of installation constitutes acceptance of Concrete Face Brick, Concrete Masonry Units, and Concrete Masonry Veneers.

E. Preparation: Prepare surfaces and materials in accordance with MSJC Specifications for Masonry Structures. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

F. Provide adequate lighting for masonry work by placing all lighting at a reasonable distance from the wall for even illumination.

3.02 PREPARATION

A. Proceed with installation only after substrate(s) are been properly prepared and within tolerances recommended by the manufacturer.

B. Commencement of installation constitutes acceptance of site conditions.

C. Draw blocks from more than one pallet at a time during installation.

D. Refer to NCMA TEK Notes, for hot and cold weather construction practices.

3.03 INSTALLATION

A. Cutting: Make all unit cuts, including those for bonding, holes, boxes, etc., with motor-driven masonry saws, using either an abrasive or diamond blade. Cut neatly and locate for best appearance.

B. Minimize cut blocks to greatest extent possible.

C. Concrete Masonry Units:
   1. Install concrete masonry units in accordance with industry accepted masonry practices and manufacturer's instructions.
   2. Bond Pattern: As indicated on Construction Drawings.
   3. Do not use masonry units with broken corners and edges in excess of ASTM C90 and ASTM C1634.
   4. Supporting and Forms: Construct forms as needed to adequately and safely support installed concrete masonry units until mortar has cured.

3.04 MORTAR BEDDING AND JOINTING:

A. Lay units with full mortar coverage on head and bed joints taking care not to block cores to be grouted or filled with masonry insulation.

B. Tool all joints into a concave configuration when mortar is thumbprint hard.

C. Remove mortar from the face of masonry units before it sets.

D. Tuckpoint joints of scored units for proper appearance and to prevent water penetration. Rake joints are not permitted and will be considered defective work.

E. Flashing: Install flashing at locations shown in the plans and in strict accordance with Construction Drawings, manufacturer’s instructions and accepted best practices for masonry flashing.

F. Weeps and Vents: Install weep holes and vents at proper intervals at courses above grade and at any water stops over windows, doors and beams. Consult NCMA TEK notes for proper flashing and drawings.

3.05 FLASHING

A. All flashing and accessory detailing components must be corrosion resistant.

B. Verify that all flashing, including adjacent roof flashing, has been properly installed. Extend flashing material above horizontal terminations, roofing material, drainage planes or drainage products.

C. Integrate all flashing materials with moisture resistive barriers to prevent water penetration into structure. Lap water resistive barriers over weep screed flanges in a water shedding fashion.

D. Control Joints: Determine if and where Control joints are needed. Consideration should be given to where differential movement is expected or where movement may be concentrated. Refer to NCMA TEK 10-02C for guidance on control joint locations.

3.06 INSPECTION AND CLEANING

A. Faces must conform to the requirements of ASTM C90 when viewed from twenty (20) feet at right angles to the wall with normal lighting.

B. Keep work surfaces clean during installation. Use brushes, rags and burlap to remove excess mortar lumps and smears prior to hardening on the finished surfaces.

C. Refer to Manufacturers recommendations for cleaning instructions for installed veneers.

END OF SECTION

SECTION 05 5000 - METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel and aluminum items, including:
   1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   2. Miscellaneous steel trim.
   3. Metal bollards.

B. Prefabricated ladders.

C. Downspout boots.

D. Products includes in this Section:
   1. Loose steel lintels.
   2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.

B. Section 09 9000 - Painting and Coating: Paint finish.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.

B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.

C. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.

G. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.

H. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.

I. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

J. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

K. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012.

L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

M. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

O. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.

P. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc; 2011.

Q. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

R. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

1.06 WARRANTY

A. Pre-fabricated Ladders Warranty:
   1. Manufacturer has responsibility for an extended Corrective Period for work of this Section for a period of 5 years commencing on the shipment date of the product against all the conditions indicated below, and when notified in writing from Owner, manufacturer shall promptly and without inconvenience and cost to Owner correct said deficiencies.
      a. Defects in materials and workmanship.
      b. Deterioration of material and surface performance below minimum OSHA standards as certified by independent third party testing laboratory. Ordinary wear and tearunusual abuse or neglect excepted.
      c. Within the warranty period, the manufacturer shall, at its option, repair, replace, or refund the purchase price of defective ladder.
   2. Manufacturer shall be notified immediately of defective products, and be given a reasonable opportunity to inspect the goods prior to return. Manufacturer will not assume responsibility, or compensation, for unauthorized repairs or labor. Manufacturer makes no other warranty, expressed or implied, to the merchantability, fitness for a particular purpose, design, sale, installation, or use, of the ladder; and shall not be liable for incidental or consequential damages, losses of or expenses, resulting from the use of ladder products

1.07 EXTRA MATERIALS

A. Furnish touchup kit for each type and color of paint finish provided.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Plates: ASTM A283/A283M.

C. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

D. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.

C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.

D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.

E. Bolts, Nuts, and Washers: Stainless steel.

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
   1. Painted Finish: Safety Yellow unless otherwise indicated.

B. Lintels: As detailed; prime paint finish.

2.05 PREFABRICATED LADDERS

A. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
   1. Materials: Aluminum; 2 (1), 6063 alloy, T52 temper.
   2. Finish: Manufacturer's standard clear anodized coating, comply with AAMA 611, Class 1.
   3. Manufacturers:
      a. **Basis of Design:** O'Keeffe's, Inc: Model 503/503A: www.okeeffes.com.
      b. Cotterman Co.: Series F.
      c. Or prior approved equal..
   4. Provide Platform and Return designed to accommodate building and parapet height.
   5. Ladder Rungs: 1 1/4" serrated square rungs made from tubular aluminum extrusions. Rungs shall withstand a 1,500 pound load without deformation or failure.
   6. Side Channel Rails: Not less than 1/8 inch (3 mm) wall thickness by 3 inches (76 mm) wide.
   7. Landing Platform: 1-1/2 inches (38 mm) or greater diameter, tubular aluminum guardrails and decks of serrated aluminum treads.
   8. Provide intermediate brackets as required based on building height.

2.06 DOWNSPOUT BOOTS

A. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots, integral cleanout, cleanout cover, and tamper proof fasteners.
   1. Configuration: As indicated in drawings.
   2. Material: Cast aluminum
   3. Finish: Manufacturer's standard factory applied powder coat finish.
   4. Color: To be selected by Architect from manufacturer's full range.
   5. Accessories: Manufacturer's standard stainless steel fasteners, stainless steel building wall anchors, integral neoprene gaskets, and rubber coupling.
   6. Manufacturers:
      a. Kinetic Architectural Products: www.kineticarch.com.
      b. Barry Pattern & Foundry: www.barrycraft.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.

2.07 FINISHES - STEEL

A. Prime paint steel items.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

2.08 FINISHES - ALUMINUM

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

B. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils (0.01 mm) thick.

C. High Performance Organic Coating System: AAMA 2604 multiple coat, thermally cured fluoropolymer system; color as indicated.

2.09 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips, flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
   1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.10 FABRICATION TOLERANCES

A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).

C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).

D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).

E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

2.11 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with primer specified in Section 09 9000, or Section 09 9600 where indicated.

2.12 METAL DOWNSPOUT BOOTS

A. Provide downspout boots made from cast aluminum in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.

2.13 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.

C. Prime loose steel lintels located in exterior walls with primer specified in Section 09 9000 or Section 09 9600, as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation, with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.04 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Perform field welding in accordance with AWS D1.1/D1.1M.

D. Obtain approval prior to site cutting or making adjustments not scheduled.

E. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.05 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

SECTION 05 5813 - METAL COLUMN COVERS

PART 1 – GENERAL

1.01 SUMMARY

A. Extent of Column Covers System as shown on drawings and schedules

B. Drawings and general provisions of the Contract Documents apply to work of this section.

1.02 SUBMITTALS

A. Submit complete shop drawings indicating quantities, dimensions, finishes, and attachment details.

B. Submit manufacturers product data, specification, and installation instructions.

C. Submit color and finish samples to verify color, pattern and finish specified. Standard sample sizes are 3.5” x 5” and 5” x 7”.

1.03 QUALITY ASSURANCE

A. Manufacturer shall have a minimum of 5 years experience in manufacturing architectural metals.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the project site in manufacturer's original packaging, properly labeled for identification and installation purposes.

B. Store in location to avoid damage from job-site traffic, direct sunlight, moisture, stacking or other job-site contaminates.

C. Handle components to avoid denting or scratching of finished surfaces.

1.05 WARRANTY

A. Provide manufacturers warranty against defects in material and workmanship for a period of one year.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Móz Designs, Inc.: www.mozdesigns.com

2.02 METAL COLUMN COVERS

A. Basis of Design: Moz Metal Column Covers

B. Material:
   1. .090” Aluminum: Type 5052 alloy complying with ASTM B209 OR
   2. 18 GA Stainless Steel: Type 304 stainless steel, complying with ASTM A789

C. Finish:
   1. Collection Name, Color Name
   2. Pattern or Grain Name (if applicable)
   3. Finish: Polycoat Gloss (GL) or Matte (MA), Durafilm Satin, Tuffcoat, Powder coat, Duranar, Or Embossed Stainless.
   4. Exterior: Y/N, see drawings
   5. Provide factory applied removable plastic film for protection during fabrication and installation.

D. Type:
   1. Shape:
      a. MOZ CC150 Square Series Column Covers
   2. Full or Partial Surround in X Sections
   3. Width/Diameter/Size: (TBD)
   4. Overall Height: (TBD)
   5. Vertical butt joints (VBJ)
   6. Optional Add-ons:

a. Vertical Open Reveals (VOR)
b. Horizontal Open Reveals (HOR) as shown on drawings
c. Recessed Base (RB) 6” brushed stainless
d. Recessed Capital (RC) 6” brushed stainless

2.03 FABRICTION

A. Column manufacturer to pre-form column covers to specified dimensions and diameters as indicated on shop drawings.

B. Provide column covers in sections a maximum 12'-0" tall per section.

C. Provide additional sections to achieve finished heights above 12'-0".

D. Columns shall have no exposed fasteners unless specified.

E. Provide additional bracing components as necessary to stiffen substructure and insure solid mid-span bracings and connections. (By others)

F. others)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine job-site conditions for conditions that may adversely affect installation of column covers.

B. Verify dimensions of column covers prior to installation to assure compatibility with job-site conditions.

C. Verify post structure is plumb, level, and parallel prior to installation of column covers.

D. Visually examine finished surfaces to assure that blemished or dented surfaces are not present prior to installation.

3.02 PREPARATION

A. A. Verify/coordinate with other trades prior to installation insofar as they are affected by column cover installation.

3.03 INSTALLATION

A. Install components in accord with manufacturer's installation instructions and approved shop drawings.

B. Anchor components to related structures such as floors, walls and beams as indicated on approved shop drawings. Use anchors with holding strength to provide a solid installation. Use only plated, galvanized or stainless steel anchors.

3.04 CLEANING

A. Remove protective coverings and clean column covers to remove adhesives and tape residue. Test all solvents on non-exposed surfaces prior to use.
1. For painted surfaces, use a mild detergent solution on a soft cloth.
2. For stainless steel, use a glass cleaner and a soft cloth.
3. For other surfaces, contact manufacturer for proper cleaning procedures.

B. Visually inspect all exposed surfaces for scratches or blemishes.

C. Protect column covers from damage during remainder of construction period.

END OF SECTION

SECTION 05 7000 - DECORATIVE METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Decorative Metal Laser Cut Screens

B. Decorative Metal Cladding

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Supports.

B. Section 09 2116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

C. Division 26 - Electrical

1.03 REFERENCE STANDARDS

A. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2014 (Amended 2015).

B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.

C. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's product data, including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.

C. Shop Drawings: Indicate quantities, dimensions, finishes, and attachment details.

D. Samples: Submit one (1) of each item below for each type and condition shown.
   1. Decorative Metal Panel: 12 inch by 12 inch (305 mm by 305 mm), illustrating color, thickness and edge condition.
   2. Decorative Metal Cladding: 4 inch by 4 inch illustrating color, pattern and finish required.

E. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.

F. Manufacturer's Installation Instructions.

G. Maintenance Data: Manufacturer's instructions for care and cleaning.

H. Manufacturer's qualification statement.

I. Installer's qualification statement.

J. Welders' qualification statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

K. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.6/D1.6M no more than 12 months before start of scheduled welding work.

D. Templates: Supply installation templates, reinforcing, and required anchorage devices.

1.06 MOCK-UPS

A. Provide mock-up of decorative metal panel and decorative metal cladding, 4 feet (____ m) long by 4 feet (____ m) wide minimum, illustrating each type of material, cladding, and finish.

B. Locate where directed.

C. Mock-up may remain as part of the work if approved by Architect.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory-provided protective coverings and packaging, properly labeled for identification and installation purposes.

B. Protect materials against damage during transit, delivery, storage, and installation at site.

C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.

D. Prior to installation, store materials and components under cover in a dry location. Store in location to avoid damage from job-site traffic, direct sunlight, moisture, stacking or other job-site contaminates. Store in a completely supported flat position. Edge storage is not recommended.

E. Handle components to avoid denting or scratching of finished surfaces.

F. DO NOT use markers on protective PVC film. Some types of ink will permeate the film and mark the material surface.

1.08 FIELD CONDITIONS

A. Do not install decorative metal panels until project is enclosed and ambient temperature of space is minimum 65 degrees F (18.3 degrees C) and maximum 85 degrees F (___ degrees C) with stable relative humidity, for at least 48 hours prior to, throughout the installation period and maintained consistently thereafter.

B. Maintain ambient temperature of space at minimum 65 degrees F (18.3 degrees C) and maximum 85 degrees F (___ degrees C) for 24 hours before, during, and after decorative metal panel installation with stable relative humidity, for at least 48 hours prior to, throughout the installation period and maintained consistently thereafter.

C. Installation locations must be enclosed, weatherproofed and climate controlled prior to commencing installation.

D. Do not install if relative humidity is greater than 80%.

E. Preconditioning of Decorative Metal Cladding: Acclimatize decorative metals, adhesives, and substrates to receive the work for a minimum of 48 hours prior to fabrication unless a greater time period is required by the substrate material manufacturer. Precondition to occupancy conditions, except maximum temperature not to exceed 75 deg F and relative humidity not to exceed 50 percent

1.09 WARRANTY

A. Laser Cut Metal Screen Warranty: Manufacturer's standard one year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

B. Decorative Metal Cladding Warranty: Manufacturer's standard one year warranty against visual defects in materials, including but not limited to spots, indents, stains, scratches, orange peel, out-of tolerance, sheet flatness, commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Laser Cut Metal Screen (**M-1, M-2**)
   1. Moz Designs, Inc.: www.mozdesigns.com.
   2. Or Prior Approved Equal

B. Decorative Metal Cladding (**M-5**)

1. Wilsonart.: www.wilsonart.com.
2. Or Prior Approved Equal

2.02 DECORATIVE METAL PRODUCTS (LASER CUT METAL SCREEN)

A. Decorative Metal Panels with Backlighting (**M-1**)
   1. Laser Cut Aluminum 'Moz Metals'
   2. 3/16" thick Aluminum: Type 5052 alloy complying with ASTM B209
   3. Sizes: Refer to Drawings
   4. Pattern: Dune Laser Cut
   5. Open Area: 11%
   6. Largest Opening: 0.53" diameter
   7. Border Thickness: 1.3"
   8. Color: Classic Light Khaki Fog Matte
   9. Finish:
      a. Matte (MA)
   10. Custom Options
      a. Double Side Finish
   11. Provide 1/8" Acrylic #2447 Diffuser Backing
      a. Thickness: 1/8"
      b. Light Transmission: 50%
      c. Finish: Matte
   12. LED Light Strips for Backlighting as recommended and provided by the Manufacturer for complete system.
      a. Voltage: 24VDC
      b. Wattage: 4.3W/ft
      c. Lumens: 2700K warm or 4200Kcool, verify desired look with Architect.
      d. Lumens per ft: 318/ft
      e. Cut points: 2 inch
      f. Max Run: 40 feet
      g. LED Chips: 36/ft
      h. CRI: 95
      i. Dimmable: Yes
      j. Dimensions: .032 x 0.1 inch (W x H)
      k. Warranty: 12 year.
      l. Constant Voltage LED Driver
         1) Input Voltage/Frequency: 120 / 277VAC / 47-63 Hz
         2) Max Load: 96 W / 4A
         3) Output Voltage: 24 VDC
         4) Dimensions: 5.38 x 1.0 x 0.77 inches (L x W x H)
         5) Warranty: 5 years
   13. Accessories: Provide all accessories and fasteners as necessary for complete system.

B. Decorative Metal Panels (**M-2**)
   1. Laser Cut Aluminum 'Moz Metals'
   2. 3/16" thick Aluminum: Type 5052 alloy complying with ASTM B209
   3. Sizes: Refer to Drawings
   4. Pattern: Dune Laser Cut
   5. Open Area: 11%
   6. Largest Opening: 0.53" diameter
   7. Border Thickness: 1.3"
   8. Color: Classic Light Khaki Fog Matte
   9. Finish:
      a. Matte (MA)
   10. Custom Options
      a. Double Side Finish

11. Accessories: Provide all accessories and fasteners as necessary for complete system.

C. Channel Panel System (**M-1, M-2**)
   1. Basis of Design: Moz Hat Channel Panel System
   2. Depth: 1 1/2"-2"
   3. Mounting screws and anchors to wall 3" o.c. through legs of hat channel.
   4. Mounting screws and anchors to panels 1 1/2" on center through panel to face of hat channel.
   5. Screws and anchors shall be in finish to match panel.

2.03 DECORATIVE METAL CLADDING

A. Basis of Design (**M-5**): Wilsonart Decorative Metals 6261-00-419 Satin Brushed Light Bronze Aluminum

B. Performance Characteristics:
   1. Surface Burning Characteristics: Unless otherwise specified, decorative metal fabrications comply with ASTM E 84 for the Class rating indicated under each decorative metal type listed in Part 2 of this Specification Section. The following values apply.
   2. Class A-1 Rated
      a. Flame spread index, 0-25
      b. Smoke-developed index, 0-450

C. Material:
   1. Aluminum Sheet: ASTM B 209. Alloy and temper to suit decorative metal application bonded to a phenolic backer and as follows:.
      a. Color Anodized: Aluminum sheet; color on exposed surface only. Bonded to a phenolic backer.
         1) Application Limitations: For non-radiused flat surfaces
         2) Sheet Thickness: 0.025 inch
         3) Overall Thickness: 0.040 inch
         4) Total Weight: 0.484 lbs. per sq. ft.
         5) Surface Burning Characteristics: Class A-I rated.
         6) Finish Conformance Standard: AAMA 611, AA-M12C22A42/A44, Class I.
         7) Color: As Indicated in Finish Key

D. Accessory Materials
   1. Bonding Adhesive: Spray-grade contact adhesive for bonding decorative metal fabrications to substrate. Complies with CID A-A-1936A
      a. Flatwork (Non-Postforming) Product: “Wilsonart® 950/951 Contact Adhesive, Flatwork Spray Grade.”
      b. Postforming Product: “Wilsonart® 800/801 Contact Adhesive, Postforming Spray Grade.”
   2. Low-VOC Bonding Adhesive: Spray-grade contact adhesive for bonding decorative metal fabrications to substrate. Complies with SCAQMD Rule 1168.
      a. Flatwork (Non-Postforming) Product: “Wilsonart® 1730/1731 Contact Adhesive, California Compliant Bulk.”
   3. Bonding Adhesive Cleaner: Solvent-based adhesive cleaner. For removing residue and overspray resulting from product installation; not for use on decorative metal surfaces. Use for Wilsonart 950/951 and Wilsonart 800/801 Contact Adhesives.
      a. Product: “Wilsonart® 121 Adhesive Cleaner.”
   4. Low-VOC Bonding Adhesive Cleaner: Solvent-based adhesive cleaner. For removing residue and overspray resulting from product installation; not for use on decorative metal surfaces. Use for Wilsonart® 1730/1731 contact adhesives.
      a. Product: “Wilsonart® 131 Low VOC Adhesive Cleaner.”
   5. Elastomeric Sealant: Mildew-resistant silicone sealant. Complies with ASTM C 920, Type S (single component), Grade NS (nonsag). Acceptable to FDA for installations subject to food contact.
      a. Product: Acceptable to decorative metals manufacturer.

b. Color: As selected from sealant manufacturer's standard offerings.

6. Construction Adhesive: Decorative metals manufacturer's recommended silicone-based construction adhesive for backsplashes, endsplashes, and other applications according to manufacturer's published fabrication instructions.

E. Fabrication
1. General: Fabricate components in shop, to greatest extent practicable, in profiles, sizes, and shapes indicated according to approved shop drawings and manufacturer's published fabrication requirements.
2. Conduct hemming, bending, roll forming, and similar assembly operations according to manufacturer's published fabrication requirements.
3. Use only cutting and fabrication tools acceptable to decorative metals manufacturer.
4. Provide holes and cutouts indicated on approved shop drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.

B. Verify field dimensions of locations and areas to receive work.

C. Notify Architect immediately of conditions that would prevent satisfactory installation.

D. Do not proceed with work until detrimental conditions have been corrected.

E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates, and supports for attachment of anchors.

3.02 PREPARATION

A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions, and directions for installation of anchorages and fasteners.

B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation. Clean surface to remove dirt, debris and loose particles. Perform additional preparation procedures as required per the manufacturer's instructions,

C. Ensure all electrical connections are in place prior to installation.

D. Protection: Take all necessary precautions to prevent damage to materials during installation

3.03 INSTALLATION OF LASER CUT PANELS

A. Comply with manufacturer's drawings and written instructions.

B. Install components, including electrical components, plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.

C. Anchor securely to structure.

D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

E. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

3.04 INSTALLATION OF DECORATIVE METAL CLADDING

A. General: Install decorative metal assemblies plumb, level, and true according to approved shop drawings and manufacturer's published installation instructions.

B. For balanced panel installation, apply manufacturer's recommended backer sheet to back (unexposed) panel surface.

C. Form joints in locations shown on approved shop drawings and acceptable to manufacturer..

D. Allow for material expansion and contraction as recommended by manufacturer.

E. Spray Adhesive Application: Provide a smooth, uniform adhesive spread with a minimum 80 percent coverage on each surface; use only spray equipment approved by decorative metals

manufacturer. Apply uniform pressure over 100 percent of the area to be bonded, using approved rollers. Allow to dry according to manufacturer's recommendations. Promptly remove excess adhesive from material surfaces with specified adhesive cleaner.

F. Do not remove any protective films until completion of installation

3.05 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

3.06 FIELD QUALITY CONTROL

A. Field Services: Provide the services of the manufacturer for field observation of installation of railings.

3.07 CLEANING

A. Laser Cut Metal Screens: Remove protective film from exposed metal surfaces and clean decorative metal to remove adhesives and tape residue. Test all solvents on non-exposed surfaces prior to use.
   1. For painted surfaces, use a mild detergent solution on a soft cloth.
   2. For stainless steel, use a glass cleaner and a soft cloth.
   3. For other surfaces, contact manufacturer for proper cleaning procedures.
   4. For HEAVY CLEANING and removal of grease, use oil based mineral spirits or naphtha. Low concentration ammonia based cleaning agents such as glass cleaners may also be used.
   5. Minor scuffs can be polished out by hand with a #6 to #9 type finishing polish or wax.
   6. DO NOT treat with rubbing compounds or lacquer thinner as this may dissolve or etch the coating

B. Metal Decorative Cladding:
   1. Clean components according to manufacturer's published maintenance instructions
   2. Do not use cleaning agents containing abrasives, acids, or alkalis.
   3. Do not use ammoniated detergents or petroleum-based cleaners on non-stainless steel metal surfaces.
   4. Do not clean metal faces with solvents, paint thinner, or adhesive remover.
   5. Protect completed work from damage during remainder of construction period.

3.08 PROTECTION

A. Protect installed components and finishes from damage after installation.

B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
   1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

SECTION 06 1000 - ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sheathing.

B. Roofing nailers.

C. Roofing cant strips.

D. Preservative treated wood materials.

E. Fire retardant treated wood materials.

F. Communications and electrical room mounting boards.

G. Concealed wood blocking, nailers, and supports.

H. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Setting anchors in concrete.

B. Section 07 1300 - Self-Adhered Sheet Membrane - Transition membranes for weather barrier.

C. Section 07 2100 - Thermal Insulation: Insulative board sheathing, batt insulation

D. Section 07 2726 - Fluid Applied Non Permable Air Barrier - weather barrier.

E. Section 07 6200 - Sheet Metal Flashing and Trim: Sill flashings.

F. Section 07 7200 - Roof Accessories: Coping

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

C. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

E. AWPA U1 - Use Category System: User Specification for Treated Wood; 2012.

F. PS 1 - Structural Plywood; 2009.

G. PS 20 - American Softwood Lumber Standard; 2010.

H. SPIB (GR) - Grading Rules; 2014.

1.04 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures.

B. Product Data: Provide technical data on wood preservative materials and application instructions, fasteners.

C. Fastener type and spacing.

D. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Southern Pine, unless otherwise indicated.
   2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

C. Provide dressed lumber, S4S, unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

A. Wall Sheathing: Plywood, PS 1, Grade C-C, Exterior Exposure.
   1. On roof side of parapets.
   2. Thickness: 5/8".

B. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 5/8 inch Type X fire resistant (16 mm Type X fire resistant).
   1. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   2. Edges: Square.
   3. Manufacturers:
      a. CertainTeed Corporation; GlasRoc Brand: www.certainteed.com/#sle.
      b. Georgia-Pacific Gypsum; DensGlass Sheathing: www.gpgypsum.com/#sle.
      c. Substitutions: See Section 01 6000 - Product Requirements.

C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

D. Other Applications:
   1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
   2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
   3. Other Locations: PS 1, C-D Plugged or better.

2.04 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
      a. Where rough carpentry is in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
   3. Nails, Brads, and Staples: ASTM F 1667.
   4. Power-Driven Fasteners: NES NER-272.
   5. Wood Screws: ASME B18.6.1.

6. Lag Bolts: ASME B18.2.1.
7. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
8. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
    a. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
    b. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.
9. Metal Framing Anchors
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) Alpine Engineered Products, Inc.
        2) Cleveland Steel Specialty Co.
        3) Harlen Metal Products, Inc.
        4) KC Metals Products, Inc.
        5) Simpson Strong-Tie Co., Inc.
        6) Southeastern Metals Manufacturing Co., Inc.
        7) USP Structural Connectors.
    b. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer that meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
    c. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
    1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
    2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
    3. Preservative Chemicals: Acceptable to authorities having jurisdiction.
    4. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Fire Retardant Treatment:
    1. Manufacturers:
        a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
        b. Hoover Treated Wood Products, Inc: www.frtw.com.
        c. Osmose, Inc: www.osmose.com.
    2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
        a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.

b. Treat rough carpentry items as indicated .
c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Application: Treat items indicated on Drawings, and the following:
1. Retain subparagraph below if Project includes wood adjacent to roofing or waterproofing.
2. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
3. Retain applicable items below. Insert other items that require treatment but are not likely to be indicated on Drawings.
4. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
5. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
6. Wood floor plates that are installed over concrete slabs-on-grade.

D. Preservative Treatment:
1. Manufacturers:
a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
b. Viance, LLC: www.treatedwood.com.
c. Osmose, Inc: www.osmose.com.
2. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
b. Treat lumber exposed to weather.
c. Treat lumber in contact with roofing, flashing, or waterproofing.
d. Treat lumber in contact with masonry or concrete.

PART 3 EXECUTION

3.01 PREPARATION

A. Where wood framing bears on cementitious foundations, masonry and concrete construction install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches (100 mm) and seal.

B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Provide the following specific non-structural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Towel and bath accessories.
   6. Wall-mounted door stops.
   7. Marker boards.
   8. Wall paneling and trim.
   9. Joints of rigid wall coverings that occur between studs.
   10. Other items as required.

3.04 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.05 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. At long edges provide solid edge blocking where joints occur between roof framing members.
   2. Attach to metal decking as recomended by manufacturer for high slope installation.

B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using screws.

C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.

3.06 TOLERANCES

A. Framing Members: 1/4 inch (6 mm) from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

3.07 CLEANING

A. Waste Disposal: Comply with the requirements of Section 01 7419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 06 2000 - FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finish carpentry items.
   1. Wood Moldings
   2. Wood Cased Openings

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 06 4100 - Architectural Wood Casework: Shop fabricated custom cabinet work.

C. Section 09 9000 - Painting and Coating: Painting and finishing of finish carpentry items.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data:
   1. Provide instructions for attachment hardware and finish hardware.

C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
   2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

D. Samples: Submit two samples of wood trim 12 inch (24 mm) long.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect work from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Interior Woodwork Items:
   1. Moldings, Bases **(WB-1)**
      a. Species: Poplar
      b. Finish: Painted
      c. Height: 10" unless otherwise indicated in Drawings.
      d. Profile: As indicated in Drawings.
   2. Trim, Mouldings
      a. Species: Poplar
      b. Finish: Painted
      c. 1x material in width/length indicated in drawings
      d. Profile: As indicated in Drawings.
   3. Cased Openings
      a. Species: Poplar
      b. Finish: Painted
      c. Thickness: 3/4" unless otherwise indicated in Drawings.
      d. Profile: As indicated in Drawings.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.03 LUMBER MATERIALS

A. Medium Hardness Lumber: Poplar species, Plain Sawn sawn, maximum moisture content of 13 percent for interior wood. .
   1. AWI: Grade 1
   2. Grading: In accordance with rules certified by ALSC; www.alsc.org.

2.04 FASTENINGS

A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

B. Fasteners: Of size and type to suit application; Galvanized finish in concealed locations and Galvanized finish in exposed locations, set for application of wood filler.

2.05 ACCESSORIES

A. Lumber for Shimming and Blocking: Softwood lumber of any species. To meet 06 1000 Rough Carpentary specifications.

B. Wood Filler: Solvent base, tinted to match surface finish color.

2.06 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.07 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Opaque:
      a. Color: As selected by Architect.
      b. Sheen: Semigloss.

D. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing, blocking and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure materials and components in place, plumb and level.

C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.

3.03 PREPARATION FOR SITE FINISHING

A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

B. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.04 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch (1.6 mm).

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.79 mm).

END OF SECTION

SECTION 06 4100 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.
   1. Plastic Laminate Faced Cabinets
   2. Paint Grade Cabinets
   3. Stain Grade Cabinets

B. Plastic Laminate Countertops.

C. Hardware and Accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 06 2000 - Finish Carpentary: Wood trim and moldings.

C. Section 12 3600 - Simulated Stone Countertops.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected parties (Owners, Architect, Subcontractors).

1.05 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Shop Drawings:
   1. Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   2. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
   3. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
   4. Provide proper notation of all equipment, plumbing fixtures, appliances, etc. to be installed within millwork for information, coordination and reference purposes. Include accurate dimensions in shop drawings, plans, and sections.
   5. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcing specified in other sections.
   6. Show locations ans sizes of cutouts and holes for plumbing fixtures, faucets and other items installed in arhitectural woodwork.
   7. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Product Data: Provide data for hardware accessories.
   1. For each type of product indicated, include data for hardware and accessories and finishing materials and proecesses.
   2. Include cut sheets of all equipment, plumbing fixtures, appliances, etc. to be installed within millwork for informational, coordination, and reference purposes.
   3. Include product data for all finish materials.

D. Samples for Verification:
   1. Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish, one unit for each type and finish.
   2. Submit plastic laminate, 8 by 10 inches (200 x 250mm) for each type, color, pattern, and surface finish.
   3. Submit samples of unfaced panel product used for core.

4. Submit samples of hihg-pressure decorative laminate panels (melamine on 3/4" MDF), 8 by 10 inches for each type, color, pattern, and surface finish, with edge banding on one edge.
5. Submit sample ring or sample box of full selection of color ranges for 3mm PVC edge banding. Submit edge banding 10 inches for each type, color, pattern, and surface finish.
6. Submit stain grade lumber with or for transparent finish for each species and cut, finished on 1 side and 1 edge.
7. Submit veneer leaves representative of and selected from flitches to be used for transparent finished woodwork.
8. Submit veneer faced panel products with or for transparent finish for each species and cut. Include at least one face-veneer seam and finish as specified.

E. Product certificates signed by woodwork fabricator certifying that products comply with specified requirements.

F. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience. With sufficient production capacity to produce required units without delaying the Work.
1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

B. Single-Source Responsibility for Fabrication and Installation: Engage a pre-qualified woodworking firm to assume undivided responsibility for fabricating, finishing, and installing interior architectural woodwork specified in this Section.

C. Quality Certification: Provide AWI Quality Certification Program inspection report and quality certification of completed work.
1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
2. Provide designated labels on shop drawings as required by certification program.
3. Provide designated labels on installed products as required by certification program.
4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.07 MOCK-UP

A. Mockups: Prior to fabricating or installing paneling, casework, and laminate casework, construct mockups of each seperate finish to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mockups of one unit, attached to wall, with one typical upper cabinet unit and one typical lower cabinet unit with counter and base drawer, using materials indicated for final unit of work, and complying with the following requirements. Mockup to be working model with all hardware as specified. Provide additional mockups as indicated in Drawings.
1. Locate mockups on site in the location indicated or, if not indicated, as directed by Architect.
2. Notify Architect one week in advance of the date and time when fabrication of mockup will begin.
3. Notify Architect one week in advance of the date and time when mockups will be installed.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's acceptance of mockups before start of final unit of Work.
6. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

a. Accepted mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

B. Mock-up may remain as part of the Work, once approved by Architect.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.

B. Do not deliver woodwork until painting and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Field Conditions" below.

C. Protect units from moisture damage.

1.09 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet-work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

C. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Verify locations of concealed framing, blocking, reinforcements, and furring that support woodwork by accurate field measurements before being enclosed. Record measurements on final shop drawings.
2. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site and coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions. Filler panels are not to exceed 1 ½" each side of a run.

1.10 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Vertical Grade Plastic Laminate Faced Cabinets: AWI Preminum Grade.

1. AWI Cabinet Type Construction: Flush overlay doweled joinery unless otherwise indicated in Drawings. Use of MDF cores required where indicated on Drawings.
2. Materials for exposed and semi-exposed surfaces (per AWI)
   a. Exposed exteriors and door and drawer faces: Vertical grade premium plastic laminate on 3/4" MDF core.
   b. Exposed interiors, door and drawer faces, and shelving: Vertical grade premium plastic laminate on 3/4" MDF core.
   c. Semi-Exposed Interiors:
      1) Cabinet Body Tops, Bottoms, and Sides: High-pressure decorative laminate (melamine) on 3/4" MDF core
      2) Cabinet Body Backs: High-pressure deorative laminate (melamine) on 1/2" MDF core

3) Drawer Body Sides and Back: High-pressure decorative laminate (melamine) on 1/2" MDF core, provide dust panels of 1/4" MDF or tempered hard board above compartments and drawers except where located directly under tops.
4) Drawer botoms: High-pressure decorative laminate (melamine) on 1/4" MDF core.

d. Concealed Toe Kicks: 3/4" exterior marine grade plywood front and backs with intermediate 3/4" exterior marine grade plywood gussets. No leg levelers shall be permited.
e. Semi-Exposed Shelving: High-pressure decorative laminate (melamine) on 3/4" MDF core.

3. Edges:
a. 3mm PVC matching laminate in color, pattern and finish as manufactured by Canplast Inc. or approved equal. Provide Architect with full range of edge banding color selections for review and selection.
b. Edges of Plastic Laminate Shelves: 3mm PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish. Provide Architect with full range of edge banding color selections for review and selection.

C. Wood Veneer Faced Cabinets Opaque/Painted Finish: AWI Premium Grade
1. AWI Cabinet Type Construction: Flush overlay doweled joinery unless otherwise indicated in Drawings. Use of MDF cores required where indicated on Drawings. Where "Raised Panel" door styles are required, use paint grade poplar for raised trim.
2. Materials for exposed and semi-exposed surfaces (per AWI)
a. Exposed exteriors and door and drawer faces: Paint Grade A veneer on 3/4" MDF core
b. Exposed interiors, door and drawer faces, and shelving: Paint Grade B veneer on 3/4" MDF core
c. Semi-Exposed Interiors:
1) Cabinet Body Tops, Bottoms, and Sides: High-pressure decorative laminate (melamine) on 3/4" MDF core
2) Cabinet Body Backs: High-pressure deorative laminate (melamine) on 1/2" MDF core
3) Drawer Body Sides and Back: High-pressure decorative laminate (melamine) on 1/2" MDF core, provide dust panels of 1/4" MDF or tempered hard board above compartments and drawers except where located directly under tops.
4) Drawer botoms: High-pressure decorative laminate (melamine) on 1/4" MDF core.

d. Concealed Toe Kicks: 3/4" exterior marine grade plywood front and backs with intermediate 3/4" exterior marine grade plywood gussets. No leg levelers shall be permited.
e. Semi-Exposed Shelving: High-pressure decorative laminate (melamine) on 3/4" MDF core.

3. Edges:
a. Paint Grade A Maple edges for doors, drawers, and shelves.

D. Wood Veneer Faced Cabinets Transparent/Stained Finish: AWI Premium Grade.
1. AWI Cabinet Type Construction: Flush overlay doweled joinery unless otherwise indicated in Drawings. Use of MDF cores required where indicated on Drawings.
2. Materials for exposed and semi-exposed surfaces (per AWI)
a. Exposed exteriors and door and drawer faces: Paint Grade A Walnut veneer on 3/4" MDF core.
b. Exposed interiors, door and drawer faces, and shelving: Paint Grade B Walnut veneer on 3/4" MDF core.
c. Semi-Exposed Interiors:
1) Cabinet Body Tops, Bottoms, and Sides: High-pressure decorative laminate (melamine) on 3/4" MDF core

2) Cabinet Body Backs: High-pressure deorative laminate (melamine) on 1/2" MDF core
3) Drawer Body Sides and Back: High-pressure decorative laminate (melamine) on 1/2" MDF core, provide dust panels of 1/4" MDF or tempered hard board above compartments and drawers except where located directly under tops.
4) Drawer botoms: High-pressure decorative laminate (melamine) on 1/4" MDF core.

d. Concealed Toe Kicks: 3/4" exterior marine grade plywood front and backs with intermediate 3/4" exterior marine grade plywood gussets. No leg levelers shall be permited.
e. Semi-Exposed Shelving: High-pressure decorative laminate (melamine) on 3/4" MDF core.

3. Edges:
   a. Contractor to provide "Woodgrain" 3mm PV edge banding to match wood species and stain to be provided at millwork locations to receive veneer. Architect to choose from full range of edge banding manufacturer's colors and selections. Contractor to provide samples for review and acceptance as manufactured by Canplast Inc. (800) 599-4455 or approved equal.
4. Stain Grade Veneer Information
   a. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
   b. Matching of Veneer Leaves: Book Match
   c. Stain: Coordinate with door manufacturer for matching custom stain.
   d. Vertical Matching of Veneer Leaves: End Match.
   e. Veneer Matching within Panel Face: Running Match.
   f. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continous match where veneers are interrupted perpendicular to the grain.
   g. Comply with veneer and other matching requirements indicated for blueprint matched paneling.

2.02 WOOD-BASED COMPONENTS

A. Lumber Standards: Comply with DOC PS 20, “American Softwood Lumber Standard,” for lumber and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee Board of Review.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
   1. SPIB - Southern Pine Inspection Bureau.
   2. WWPA - Western Wood Products Association.

C. Softwood Plywood: Comply with U.S. Commercial Standards, CS45.

D. Hardwood Plywood: Comply with U.S. Commercial Standards, CS45.

E. Hardboard (including soft hardwoods) and Lumber Core Hardwood Veneer: All finish exposed hardwood to comply with grading of American Woodworking Institute.

F. Hardwood Edgebanding: Use solid hardwood edgebanding matching species, color, grain, and grade for exposed portions of cabinetry.

2.03 HIGH-PRESSURE PLASTIC LAMINATE MATERIALS

A. Manufacturers:
   1. Basis of Design (**PL-4**): Formica Corporation: www.formica.com.
   2. Basis of Design (**PL-1, PL-2, PL-5**): Wilsonart: www.wilsonart.com.
   3. Basis of Design (**PL-3**): Panolam Surface System (Nevamar, Pionite, or Panolam): www.panolam.com.
   4. Laminart: www.laminart.com.
   5. Or prior approved equal.

B. High Pressure Decorative Laminate (HPDL) Melamine: NEMA LD 3, types as recommended for specific applications, unless indicated other wise on finish schedule.

C. Provide specific types as indicated.
   1. Horizontal Surfaces: HGS, 0.048 inch (1.22 mm) nominal thickness, through color, colors as scheduled, finish as scheduled.
   2. Vertical Surfaces: VGS, 0.028 inch (0.71 mm) nominal thickness, through color, colors as scheduled, finish as scheduled.
   3. Post-Formed Horizontal Surfaces: HGP, 0.039 inch (1.0 mm) nominal thickness, through color, colors as scheduled, finish as scheduled.
   4. Edges: GHGS, 0.048 inch (1.22 mm) nominal thickness, through color, colors as scheduled, finish as scheduled.

D. Adhesive for Bonding Plastic Laminate: Urea-formaldehyde.

2.04 COUNTERTOPS

A. Non Laminate, Solid Surface Countertops are specified in Section 12 3600.

B. Plastic Laminate Countertops:
   1. Wet Loations: High-pressure decorative plastic laminate finish as scheduled on 3/4" Extira MDF core.
   2. All other locations: High-pressure decorative plastic laminate finish as scheduled on 3/4" MDF core conventionally fabricated.
   3. Edges:
      a. Self-Edge Band - or - Color Matching T-Mold, Basis of Design: Charter Industries.

2.05 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Fasteners: Size and type to suit application.

C. Concealed Joint Fasteners: Threaded steel.

D. Grommets: Basis of Design: Doug Mockett 2-1/2" Solid Brass Grommet Cap and Liner Set, Finish to be selected from Manufacturer's full range. Locations of Grommets to be verified in field prior to installation

2.06 HARDWARE

A. Provide hardware and accessory materials associated with architectural cabinets.
   1. Approved cabinet hardware manufacturers as follows or as specified in drawings:
      a. Doug Mockett
      b. Grant.
      c. Knape & Vogt Manufacturing Company
      d. Lescoa.
      e. Stanley.
      f. Blum.
   2. Cabinet hardware to be supplied and installed by millworks shall include all drawer slides, and shelf and countertop supports.

B. Hardware Standard: Comply with BHMA A156.9 for items indicated by reference to BHMA numbers or referenced to this standard.

C. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA code number indicated.
   1. BHMA 613 or Satin Stainless Steel, Stainless-Steel Base: BHMA 630. (Or as specified in drawings).

D. For concealed hardware provide manufacturer’s standard finish that complies with product class requirements of BHMA A156.9.

E. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, satin chrome finish, for nominal 1 inch (25 mm) spacing adjustments.

1. Shelf Rests: 5 mil metal pin style; clear finish.

F. Concealed In-Wall (Pre-Drywall) Workstation and Countertop Brakets:
   1. Material: Heavy-Duty Aluminum Bracket
   2. Finish: Color to be selected from Manufacturer's full range.
   3. Installation: Per Manufacturer's Recommendation. Spacing not to exceed 3'-0" on center, Contractor to verify load capacity per bracket.
   4. Size: Contractor to coordinate size of bracket required with countertop depth.
   5. Manufacturers:
      a. Rakks Concealed EH Countertop Support Bracket
      b. Doug Mockett
      c. Richelieu Hardware

G. Floating Glass Shelf Supports
   1. Manufacturers:
      a. Basis of Design: Doug Mockett SSH48B- Large Elegant Shelf Brackets
      b. Or Approved Equal
   2. Size: 13/32" min. to 1 7/8" max. shelf thickness, 1 3/16" wide, 9 1/32" projection.
   3. Weight Capacity: 25 lbs per bracket. Space no more than 24" apart.
   4. Color as selected from Manufacturers Full Range.

H. Drawer and Door Pulls: _____.
   1. Basis of Design: Amerock Bar Pulls 5 1/16" (120mm) center to center pull unless noted otherwise in Drawings. Finish to be selected from Manufacturer's full range.

I. Cabinet Locks and Drawer Locks: Self-Locking, Keyless Push Button locks at locations indicated in Drawings.
   1. Manufacturer:
      a. Basis of Design: CompX ecoForce Push Button Cabinet Lock with SlamCAM.
   2. Lock shall allow one user code from one to five digits long. Shall allow user to simultaneously press up to five digits at one time. Shall include a code discoverable feature.
   3. Provide key override.
   4. Self-locking feature with spring loaded latch.
   5. Mounting: Recessed.

J. Drawer Slides:
   1. Static Load Capacity: Heavy Duty grade.
      a. Grade 1HD-100 and Grade 1HD-200
      b. Side-Mounted, 3/4" extension type.
      c. Zinc-plated steel ball bearing slides.
   2. Mounting: Side mounted.
   3. Stops: Integral type.
   4. Features: Provide self closing/stay closed type.
   5. Manufacturers:
      a. Accuride International, Inc; KV 8400 3/4" extension types 3832 series: www.accuride.com.
      b. Blum, Inc: www.blum.com.
      c. Grass America Inc: www.grassusa.com.
      d. Knape & Vogt Manufacturing Company: www.knapeandvogt.com.

K. Box Drawer Slides:
   1. Location: For drawers not more than 6" high and 24" wide.
   2. Rated for 75 lbs.
   3. Grade 1HD-100
   4. Mounting: Side mounted.
   5. Manufacturers:
      a. Basis of Design: Blum: www.blum.com

b. Accuride International, Inc.: www.accuride.com
c. Grass America, Inc.: www.grassusa.com
d. Knape & Vogt Manufacturing Company: www.knapeandvogt.com

L. Waste Bin Pull Out:
1. Manufacturer:
a. Hafale Matrix, Single Waste Bin Pull Out
2. Waste Bin Frame:
a. Double wall steel frame system with full extension progressive action runners.
b. Color: White
3. Bottom and Back: White Melamine
4. Waste Bin: 52 quart
a. Quantity: 1
b. Color: White

M. Hinges: European style concealed soft-closing type, steel with satin finish.
1. BHMA A156.9, B01602
2. 120 degrees of opening.
3. Manufacturers:
a. Grass America Inc: www.grassusa.com.
b. Julius Blum, Inc: www.blum.com.
c. Salice: www.salice.com

N. Z-Clips: Aluminum Z-clips for millwork panel attachment
1. Material: Aluminum
2. Manufacturers:
a. Basis of Design: Rockler Eagle-Clip 2" Z-Clip
b. Eagle Mouldings
c. Monarch Metal
3. Size: 1 1/4"H x 2" wide with 0.20" punched holes for installation

2.07 FABRICATION

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet (600 mm) from sink cut-outs.
1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
2. Cap exposed plastic laminate finish edges with material of same finish and pattern.

E. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as indicated in Drawings

F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before installing.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

3.03 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.

B. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) for plumb and level (including tops).

C. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

D. Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

E. Use fixture attachments in concealed locations for wall mounted components.

F. Use concealed joint fasteners to align and secure adjoining cabinet units.

G. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.

H. Secure cabinets to floor using appropriate angles and anchorages.

I. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.04 ADJUSTING

A. Repair damaged and defective woodwork where possible to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

D. Adjust moving or operating parts to function smoothly and correctly.

3.05 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to fabricator and Installer that ensures that woodwork is without damage or deterioration at the time of Substantial Completion

3.06 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 06 8200 - GLASS FIBER REINFORCED PLASTIC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass fiber reinforced, resin fabrications.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Provide data on specified component products.

C. Manufacturer's installation instructions

D. Shop Drawings: Indicate design load parameters, dimensions, adjacent construction, materials, thicknesses, fabrication details, required clearances, field jointing, tolerances, colors, finishes, methods of support, integration of plumbing components, and anchorages.

E. Samples: Submit two Samples of Wall Panel, and all pieces of associated trim, 4x4 inch (100 x 100 mm) in size, illustrating color, texture, and finish.

F. Maintenance Data: Include instructions for stain removal, surface and gloss restoration .

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in architectural glass fiber and resin components with two years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect components from damage by retaining shipping protection in place until installation.

1.06 FIELD CONDITIONS

A. Do not install site fabricated components when site conditions may be detrimental to successful installation.

B. Maintain temperature and humidity conditions favorable to proper curing of resin during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glass Fiber and Resin Fabrications (**FRP-1**):
   1. Crane Composites, INc. (Kemlite).
   2. Basis of Design: Marlite
   3. Nudo Products, Inc.
   4. Or prior approved equal.

2.02 MATERIALS

A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.
   1. Nominal Thickness: Not less than 0.09 in.

B. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.03 SHOP FABRICATION

A. Mold Material: FRP type.

B. Mold Surface: Textured to achieve pebble texture finish.

C. Finish trim corners, Batten strips, and edges.

D. Coat exposed surfaces with gel coat of colored resin.

E. Cure components prior to shipment and remove material that may be toxic to plant or animal life.

2.04 FINISH

A. Color: As selected specified in Finish Key.

2.05 ACCESSORIES

A. Trim Accessories: Manufacturer's standard vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
   1. Color: Match panels.

B. Exposed Fasteners: Nylon drive rivets as recommended by panel manufacturer.

C. Concealed Mounting Splines: Continuous H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive: As recommended by plastic paneling manufacturer.
   1. VOC Content: 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Sealant: Sealant as recommended by plastic paneling and complying with requirements in Division 07 Section "Joint Sealants".

PART 3 EXECUTION

3.01 EXAMINATION

A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.02 INSTALLATION, GENERAL

A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
   1. Respective manufacturer's written installation instructions.
   2. Accepted submittals.
   3. Contract Documents.

3.03 PREPARATION

A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

B. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.

C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

D. Lay out paneling before installing. Locate panel so that trimmed panels at corners are not less than 12 in. wide.
   1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
   2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.04 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive.

D. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

3.05 TOLERANCES

A. Maximum variation from true position: 1/4 inch (6 mm).

B. Maximum offset from true alignment: 1/8 inch (3 mm).

3.06 CLEANING

A. Clean components of foreign material without damaging finished surface.

B. Hand rub smooth surfaces with polishing cream.

C. Clean fabrications in accordance with fabricator's instructions.

3.07 PROTECTION

A. Place protective structural covering over installed units.

END OF SECTION

SECTION 06 8313 - TRANSLUCENT RESIN PANEL SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the Plastic Fabrication as shown and specified in the described system(s):
   1. Millwork
   2. Feature Wall/Wall Cladding
   3. Partitions

B. Related Sections include the following:
   1. Section 06 2000 - Finish Carpentry
   2. Section 06 4100 - Architectural Wood Casework.

1.03 SUBMITTALS

A. General: Submit the following in accordance with conditions of contact and Division 1 specification section 01 3000 “Submittal Procedures”.

B. Product Data: Submit manufacturer’s product data; include product description, fabrication information, and compliance with specified performance requirements.

C. Submit product test reports from a qualified independent 3rd party testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.
   1. Test reports required are:
      a. Rate of Burning (ASTM D 635)
      b. Self-Ignition Temperature (ASTM D 1929)
      c. Density of Smoke (ASTM D 2843)
      d. Flame spread and Smoke developed testing (ASTM E 84)
      e. Room Corner Burn Test (NFPA 286)
      f. Extent of Burning (UL 94)
      g. Impact strength (ASTM D 3763)
      h. Safety glazing impact resistance (ANSI Z97.1-2004)
      i. UPITT Test for Combustion Product Toxicity
      j. Dynamic environmental testing (ASTM standards D 5116 and D 6670)

D. Building Approvals: Plastic Fabrications are to have been evaluated and must be registered with and comply to requirements of the following jurisdictions:
   1. New York Department of Buildings (Product must have an MEA [Materials and Equipment Acceptance] number) for use as Interior Finishes
   2. Los Angeles Department of Building and Safety (Product must have a LARR [Los Angeles Research Report] number) for use as Light-transmitting Panels

E. Shop Drawings: Include plans, elevations, sections, panel dimensions, details, and attachments to other work.

F. Samples for Initial Selection:
   1. Submit minimum 2-inch by 2-inch samples. Indicate full color, texture and pattern variation.

G. Samples for Verification:
   1. Submit minimum 4-inch by 4-inch sample for each type, texture, pattern and color of solid plastic fabrication.

H. Mockups:
   1. Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects.

2. Build mockup of each type of Plastic Fabrication.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.04 QUALITY ASSURANCE

A. Manufacturers Qualifications
1. Materials and systems shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least five (5) consecutive years and which can show evidence of those materials being satisfactorily used on at least six (6) projects of similar size, scope and location. At least three (3) of the projects shall have been successful for use five (5) years or longer.
2. Manufactured panels must be produced from a minimum of 40% post-industrial recycle content. This recycle content must be certified by a recognized 3rd party certification group, such as Scientific Certification Systems (SCS).
3. Manufacturer must offer a documented reclaim process that will take back, at the manufacturers cost, panels that are at their end-of life cycle. Return process is preceded by following requirements highlighted in Section 02 42 00 Removal and Salvage of Construction Materials.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver Plastic Fabrications, systems and specified items in manufacturer's standard protective packaging.

B. Do not deliver Plastic Fabrications, system, components and accessories to Project site until areas are ready for installation.

C. Store materials in a flat orientation in a dry place that is not exposed to exterior elements.

D. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent damage or staining following installation for duration of project.

E. Before installing Plastic Fabrications, permit them to reach room temperature.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not install Solid Polymer Fabrications until spaces are enclosed and weatherproof, and ambient temperatures and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.07 WARRANTY

A. Manufacturer's Special Warranty on Plastic Fabrications: Manufacturer's standard form agreeing to repair or replace units that fail in material or workmanship within the specified warranty period.

B. Warranty Period: 2 year after the date of substantial completion.

C. The warranty shall not deprive the owner of other rights or remedies the Owner may have under other provisions of the Contract Documents, and is in addition to and runs concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Manufacturer: 3form, Inc. Salt Lake City, Utah, USA / telephone 801-649-2500: www.3form.com.

2.02 MATERIALS

A. Varia™ produced from ecoresin™ Sheet
1. Engineered polyester resin
2. Sheet Size: Maximum 4' x 8'
3. Thickness: Minimum 3/8"

4. Basis of Design Products **(RP-1)**: The design is based on Varia™ produced from ecoresin™ Sheet as provided by 3form, Inc. Products from other manufacturers must be approved by the Architect or Designer prior to bidding in accordance with the Instructions to Bidders and Section 01 6000 “Product Requirements”.
5. Colors and Patterns: As indicated in Drawing Finish Key.

B. Interlayer Materials: Compatible with polyesters and bonding process to create a monolithic sheet of material when complete.
1. Basis of Design **(RP-1)**: Vertu V Mini + Warmstone N56 by 3form.
   a. Pattern: Parallel to long side, cannot be rotated.
   b. Direction of Pattern: As Indicated in Drawings.

C. Back Finish **(RP-1)**: Warmstone N56

D. Front Finish **(RP-3)**: Vertu V Mini Emobss, Sandstone FO1

E. Sheet minimum performance attributes:
1. Rate of Burning (ASTM D 635). Material must attain CC1 Rating for a nominal thickness of 1.5 mm (0.060 in.) and greater.
2. Self-Ignition Temperature (ASTM D 1929). Material must have a Self-ignition temperature greater than 650°F.
3. Density of Smoke (ASTM D 2843). Material must have a smoke density less than 75%.
4. Flame spread and Smoke developed testing (ASTM E 84). Material must be able to meet a level of Class A (Flame spread less than 25 and smoke less than 450) at thickness of 1”.
5. Room Corner Burn Test (NFPA 286). Material must meet Class A criteria at ¼” thickness as described by the 2003 International Building Code.
6. Extent of Burning (UL 94). Must submit UL card.
7. Impact strength. Minimum impact strength test as measured by ASTM D 3763 of 20 ft. lbs. (for durability, shipping, installation, and use).
8. Safety Glazing. Material must attain a Class A impact rating in accordance with ANSI Z97.1-2004 at 1/8” thickness.
9. UPITT Test for Combustion Product Toxicity: Product must be recorded as “not more toxic than wood”.
10. Dynamic environmental testing (ASTM standards D 5116 and D 6670). Panels must not have detectable VOC off-gassing agents and must be have Greenguard™ Indoor Air Quality certified.
11. Panels must be produced from a minimum of 40% post-industrial recycle content. This recycle content must be certified by a recognized 3rd party certification group, such as Scientific Certification Systems (SCS).
12. Building Approvals: Plastic Fabrications are to have been evaluated and must be registered with and comply to requirements of the following jurisdictions:
   a. New York Department of Buildings (Product must have an MEA [Materials and Equipment Acceptance] number) for use as Interior Finishes
   b. Los Angeles Department of Building and Safety (Product must have a LARR [Los Angeles Research Report] number) for use as Light-transmitting Panels

2.03 FABRICATION

A. General: Fabricate Plastic Fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the drawings.

B. Comply with manufacturer’s written recommendations for fabrication.

C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.
1. Sawing: Select equipment and blades suitable for type of cut required.
2. Drilling: Drills specifically designed for use with plastic products.
3. Milling: Climb cut where possible.
4. Routing

5. Tapping

D. Forming: Form products to shapes indicated using the appropriate method listed below. Comply with manufacturer's written instructions.
   1. Cold Bending
   2. Hot Bending
   3. Thermoforming: Acceptable only on uncoated material.
   4. Drape Forming
   5. Matched Mold Forming
   6. Mechanical Forming

E. Laminating: Laminate to substrates indicated using adhesives and techniques recommended by manufacturer.

F. Exposed edges of resin panel to be buffed and finishes as required by manufacturer.

2.04 HARDWARE

A. Provide all necessary hardware for mounting of Plastic Fabrications

B. All hardware to be concealed.

C. Aluminum U Channel:
   1. Basis of Design: CR Laurence
   2. Width: As necessary to accommodate Plastic Fabrication Resin Panels.
   3. Finish: Mill Finish

2.05 MISCELLANEOUS MATERIALS

A. General: Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaner: Type recommended by manufacturer.

C. Fasteners: Use screws designed specifically for plastics. Self-threading screws are acceptable for permanent installations. Provide threaded metal inserts for applications requiring frequent disassembly such as light fixtures.

D. Bonding Cements: May be achieved with solvents or adhesives, suitable for use with product and application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions where installation of Plastic Fabrications will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for installation and comply with requirements specified.

3.02 INSTALLATION

A. General: Comply with manufacturer's written instructions for the installation of Plastic Fabrications.

B. Manufacturer's shop to fabricate items to the greatest degree possible.

C. Utilize fasteners, adhesives and bonding agents recommended by manufacturer for type of installation indicated. Material that is chipped, warped, hazed or discolored as a result of installation or fabrication methods will be rejected.

D. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.

E. Form field joints using manufacturer's recommended procedures. Locate seams in panels so that they are not directly in line with seams in substrates.

3.03 CLEANING AND PROTECTION

A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work, which cannot be repaired to Architect's satisfaction.

B. Sheets may be rinsed with lukewarm water however edges of organic or fabric interlayers shall not be exposed to water. Use a soft, damp cloth to blot dry. Do not rub with a dry cloth.

C. Remove dust and dirt with a soft cloth or sponge and a solution of mild soap or liquid detergent in water or a 50:50 solution of isopropyl alcohol and water. Rinse with lukewarm water taking care not to expose edges of organic or fabric interlayers to water. Use a soft, damp cloth to blot dry. Do not rub with a dry cloth.

D. Never use scrapers or squeegees on resin panel. Avoid scoruing compounds, gasoline, benzene, acetone, carbon tetrachloride, certain deicing fluids, lacquer thinner or other strong solvents.

END OF SECTION

SECTION 07 0553 - FIRE AND SMOKE ASSEMBLY IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Identification markings for fire and smoke rated partitions, and fire rated walls.

1.02 REFERENCE STANDARDS

A. ICC (IBC) - International Building Code; 2015.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed product literature for each type of marking, indicating font, foreground and background colors, wording, and overall dimensions.

C. Schedule: Completely define scope of proposed marking, and indicate location of affected walls and partitions, and number of markings.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.05 FIELD CONDITIONS

A. Do not install painted markings when ambient temperature is lower than recommended by coating manufacturer.

PART 2 PRODUCTS

2.01 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

A. Regulatory Requirements: Comply with "Marking and Identification" requirements of "Fire-Resistance Ratings and Fire Tests" chapter of ICC (IBC).

B. Languages: Provide sign markings in English.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Locate markings as required by ICC (IBC).

B. Install neatly, with horizontal edges level.

C. Protect from damage until Date of Substantial Completion; repair or replace damaged markings.

END OF SECTION

SECTION 07 1300 - SELF-ADHERED SHEET MEMBRANE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work of this section includes, but is not limited to the following:
   1. Materials and installation methods for air vapor barrier membrane system located in the non-accessible part of the wall.
   2. Materials and installation methods to bridge and seal air leakage pathways in roof and foundation junctions, window and door openings, control and expansion joints, masonry ties, piping and other penetrations through the wall assembly, except where otherwise covered by polyisocyanurate board with continuous facers and associated tape and flashing systems as specified in Section 07 2100.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete substrate.

B. Section 06 1000 - Rough Carpentry: Plywood Sheathing

C. Section 07 2100 - Thermal Insulation: Insulation used for protective cover.

D. Section 07 7100 Roof Specialties: Metal parapet, coping, and counterflashing.

E. Section 07 9200 - Joint Sealants: Sealing moving joints in waterproofed surfaces that are not required to be treated in this section.

F. Section 08 4313 Aluminimum Framed Entrances and Storefronts

G. Section 08 4413 Glazed Aluminum Curtain Walls

1.03 PERFORMANCE REQUIREMENTS

A. Provide an air and vapor barrier system to perform as a continuous barrier to air infiltration/exfiltration and water vapor transmission and to act as a liquid water drainage plane flashed to discharge any incidental condensation of water penetration.

1.04 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).

B. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).

C. ASTM D 1004 - Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.

D. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test); 2008 (Reapproved 2015).

E. ASTM D 1938 - Standard Test Method for Tear Propagation Resistance of Plastic Film and Thin Sheeting by a Single-Tear Method.

F. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2018.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

H. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a, with Editorial Revision (2013).

I. ASTM E 2178 - Standard Test Method for Air Permeance of Building Materials.

J. ASTM E 2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

1.05 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures, for submittal procedures.

B. Product Data: Submit manufacturer's product data, installation instructions, use limitations and substrate preparation recommendations.

C. Shop Drawings showing locations and extent of air and vapor barrier system including details for terminations flashings, penetrations, window and door openings and treatment of substrate joints and cracks.

D. Written documentation demonstrating installers qualifications under the "Quality Assurance" article including reference projects of a similar scope.

E. Samples: Submit representative samples of the following for approval:
   1. Self-Adhered Air Barrier Membrane
   2. Self-Adhered Transition Membrane
   3. Self-Adhered Through Wall Flashing

F. Warranty: Submit a sample warranty identifying the terms and conditions stated in Article 1.09 "Warranty".

1.06 QUALITY ASSURANCE

A. Manufacturer: Air and vapor barrier systems shall all be manufactured and provided by single source manufacturer.

B. Installer: The installer shall demonstrate qualifications to perform the work of this Section by submitting the following:
   1. List of at least three (3) projects contracted within the past five (5) years of similar scope and complexity to this project carried out by the firm and site supervisor.
   2. Installer must show evidence of adequate equipment and trained field personnel to successfully complete the project in a timely manner.

C. Materials: Self-adhered air and vapor barrier material shall be 40 mil (.004 in) comprising 36 mil (.0036 in) rubberized asphalt integrally bonded to 4 mil (.004 in) cross-laminated polyethylene film. For each type of material required for the work of this Section, provide primary materials that are the products of one manufacturer.

D. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include but not be limited to the following:
   1. Review of submittals.
   2. Review of surface preparation, minimum curing period and installation procedures.
   3. Review of special details and flashings.
   4. Sequence of construction, responsibilities and schedule for subsequent operations.
   5. Review of mock-up requirements.
   6. Review of inspection, testing, protection and repair procedures.

E. Mock-up:
   1. Prior to installation of the air and vapor barrier system a field-constructed mock-up shall be provided under the provisions of Section 01 3300 - Submittals to verify details and tie-ins and to demonstrate the required quality of materials and installation.
   2. Construct a typical exterior wall section, 8 feet long and 8 feet wide, incorporating back-up wall, cladding, window and doorframe and sill, insulation, flashing and any other critical junction (roof, foundation, etc.).
   3. Allow 24 hours for inspection and testing of mock-up before proceeding with air and vapor barrier work.
   4. Mock-up may remain as part of the work.

F. Inspection and Testing: Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover any installed air and vapor barrier membrane until it has been inspected, tested and approved.

G. Product compatibility: Manufacturer to provide written verification that product is compatible with substrates to which it will be attached, including tape and insulation board.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

B. Do not double-stack pallets of fluid applied membrane components on the job site. Provide cover on top and all sides, allowing for adequate ventilation.

C. Protect fluid-applied membrane components from freezing and extreme heat.

D. Sequence deliveries to avoid delays, but minimize on-site storage.

1.08 PROJECT CONDITIONS

A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials used. Proceed with installation only when the substrate construction and preparation work is complete and in condition to receive the air and vapor barrier membrane.

1.09 WARRANTY

A. See Section 017800 - Project Closeout, for additional warranty requirements.

B. Submit manufacturer's warranty that air and vapor barrier and accessories are free of defects at time of delivery and are manufactured to meet manufacturer's published physical properties and material specifications.

PART 2 PRODUCTS

2.01 GENERAL

A. For each type of material required for the work of this section, provide primary materials that are the products of one manufacturer.

2.02 MANUFACTURERS

A. Perm-A-Barrier, as manufactured by Grace Construction Products.

B. Blueskin, as manufactured by Henry Company

C. Carlisle Coatings & Waterproofing

D. Or prior approved equal.

2.03 SELF-ADHERED AIR BARRIER MEMBRANE

A. Description: Min. 1 mm (.040 in) thick membrane comprised of 0.9 mm (.036 in) of self-adhesive rubberized asphalt integrally bonded to 0.1 mm (.004 in) of cross-laminated, high-density polyethylene film. Membrane shall be interleaved with disposable silicone-coated release paper until installed.

B. Performance Requirements:

Property	Test Method	Typical Value
Thickness	ASTM D 3767 Method A	1.0 mm (0.040 in) nominal
Air Permeance at 75Pa (0.3 in water) Differential Pressure	ASTM E 2178	<0.001 L/(s.sq.m) (<0.0002 cfm/sq. ft.)
Assembly Air Permeance at 75Pa (0.3 in water) Differential Pressure	ASTM E 2357	<0.004 L/s.sq.m) (<0.0008 cfm/sq. ft)
Water Vapor Permeance	ASTM E 96, Method B	Less than 2.9 ng/Pa.s.sq. m (0.05 Perms)
Water Absorption	ASTM D 570	Max 0.1% by weight
Puncture Resistance	ASTM E 154	178 N (40 lbs)
Tear Resistance	Initiation - ASTM D 1004 Propagation - ASTM D 1938	Min. 58 N (7.0 lbs.) M.D. Min. 40 N (4.0 lbs.) M.D.

Lap Adhesion at -4 deg C (25 deg F)	ASTM D 1876	880 N/m (5.0 lbs/in) of width
Low Temperature Flexibility	ASTM D 1970	Unaffected to -43 deg C (-45 deg F)
Tensile Strength	ASTM D 412, Die C Modified	Min. 2.7 MPa (400 psi)
Elongation, Ultimate Failure of Rubberized Asphalt	ASTM D 412 - Die C	Min. 500%

C. Materials:
1. Perm-A-Barrier Wall Membrane from Grace Construction Products, 62 Whittemore Avenue, Cambridge, MA or approved equal.
2. Blueskin VP 160 from Henry Company.
3. Carlisle CCW-705 from Carlisle Coatings & Waterproofing.
4. Or approved equal.

2.04 TRANSITION MEMBRANE

A. Description: Min. 1 mm (.040 in) thick membrane comprised of 0.9 mm (0.036 in) of self-adhesive rubberized asphalt integrally bonded to 0.1 mm (.004 in) of cross-laminated, high-density polyethylene film. Membrane shall be interleaved with disposable silicone-coated release paper until installed.

B. Performance Requirements:
1. Water Vapor Transmission: ASTM E 96, Method B: 2.9 ng/m2xPa (0.05 perms) max.
2. Air Permeance at 75Pa (0.3 in water) pressure difference: 0.0006 L/(s.m sq) (0.00012 cfm/sq ft)
3. Puncture Resistance: ASTM E 154: 178 N (40 lbs) min.
4. Lap Adhesion at -4 deg C (25 deg F), ASTM D 1876: 880 N/m (5.0 lbs/in) of width min.
5. Low Temperature Flexibility, ASTM D 1970: Unaffected to -43 deg C (-45 deg F)
6. Tensile Strength, ASTM D 412, Die C Modified: min. 2.7 MPa (400 psi)
7. Elongation, Ultimate Failure of Rubberized Asphalt, ASTM D 412 Die C: min. 200%

C. Materials:
1. Perm-A-Barrier Detail Membrane manufactured by Grace Construction Products.
2. Blueskin SA, by Henry Company
3. Carlisle; product as recommended by manufacturer.
4. Or approved equal.

2.05 FLEXIBLE MEMBRANE WALL FLASHING

A. Description: Min. 1 mm (.040 in) thick membrane comprised of 0.8 mm (0.032 in) of self-adhesive rubberized asphalt integrally bonded to 0.2 mm (.008 in) of cross-laminated, high-density polyethylene film. Membrane shall be interleaved with disposable silicone-coated release paper until installed.

B. Performance Requirements:
1. Water Vapor Transmission, ASTM E 96, Method B: 2.9 ng/m2sPa (0.05 perms) max.
2. Water Absorption, ASTM D 570: max. 0.1% by weight
3. Puncture Resistance, ASTM E 154: 356 N (80 lbs) min.
4. Tear Resistance
   a. Initiation ASTM D 1004: min. 58 N (13.0 lbs) M.D.
   b. Propagation ASTM D 1938: min. 40 N (9.0 lbs) M.D.
5. Lap Adhesion at -4 deg C (25 deg F), ASTM D 1876: 880 N/m (5.0 lbs/in) of width

6. Low Temperature Flexibility, ASTM D 1970: Unaffected to -43 deg C (-45 deg F)
7. Tensile Strength, ASTM D 412, Die C Method: min. 5.5 MPa (800 psi)
8. Elongation, Ultimate Failure of Rubberized Asphalt, ASTM D 412, Die C: min. 200%

C. Materials:
1. Perm-A-Barrier Wall Flashing manufactured by Grace Construction Products.
2. Blueskin TWF by Henry Company.
3. Carlisle; product as recommended by manufacturer.
4. Or approved equal.

2.06 AIR & VAPOR BARRIER ACCESSORIES

A. Primer: Water-based primer which imparts an aggressive, high tack finish on the treated substrate
1. Flash Point: No flash to boiling point
2. Solvent Type: Water
3. VOC Content: Not to exceed 10 g/l
4. Application Temperature: -4 deg C (25 deg F) and above.
5. Freezing point (as packaged): -7 deg C (21 deg F)

Product: Perm-A-Barrier WB Primer manufactured by Grace Construction Products; Blueskin Spray Prep by Henry Company; Carlisle; or approved equal.

B. Sealant: Two-part, elastomeric, trowel grade material designed for use with self-adhered membranes and tapes. 10 g/l max. VOC Content.

Product: Bituthene Liquid Membrane manufactured by Grace Construction Products; HE925 BES by Henry Company; Carlisle, or approved equal.

C. Optional Primers:
1. Description: High tack water based primer: 10 g/l max. VOC content.
Product: Perm-A-Barrier Liquid Part B manufactured by Grace Construction Products.
2. Description: High tack low VOC solvent based primer. <200 g/l max. VOC content.
Product: Bituthene Primer B2 LVC manufactured by Grace Construction Products.
3. Description: High tack solvent based primer. 440 g/l max. VOC content.
Product: Bituthene Primer B2 manufactured by Grace Construction Products.

PART 3 EXECUTION

3.01 EXAMINATION

A. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the Work. Do not proceed with work until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be sound adn free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and was from exposed surfaces. Remove dust, dirt, loose-stone and debris. Use repair materials and methods that are acceptable to manufacturer of the fluid-applied waterproofing.

B. Exterior sheathing panels: Ensure that the boards are sufficiently stabilized with corners and edges fastened with appropriate screws in accordance with exterior sheathing manufacturers written instructions.

C. Masonry Substrates: Apply air and vapor barrier over concrete block and brick with smooth and flush mortar joints. Fill all voids and holes, particularly in the mortar joints, with a lean mortar mix, non-shrinking grout or purge coat.

D. Related Materials: Treat construction joints and install flashing as recommended by air barrier manufacturer.

3.03 INSTALLATION

A. Refer to manufacturer's literature for recommendations on installation.

B. Apply air barrier membrane to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

C. Application of Self-Adhered Air Barrier Membrane
   1. Install air and vapor barrier to dry surfaces at air and surface temperatures of -4 deg C (25 deg F) adn above in accordance with manufacturer's recommendations, at locations indicated on Construction Documents.
   2. Prime substrate to receive air barrier membrane as required per manufacturers written instructions.
   3. Precut substrate to receive air barrier membrane as required per manufacturers written instructions.
   4. Remove silicone-coated release paper and position membrane carefully before placing length horizontally against the surface.
   5. Begin installation at the base of the wall placing top edge of membrane immediately below any masonry reinforcement or ties protruding from substrate.
   6. When properly positioned, place against surface by pressing firmly into place. Roll membrane with extension-handled counterop roller immediately after placement.
   7. Overlap horizontally adjacent pieces 50 mm (2 in) and roll seams.
   8. Subsequent sheets of membrane applied above shall be positioned immediately below masonry reinforcement or ties. Bottom edge shall be slit to fit around reinforcing wires or tires, and membrane shall overlap the membrane sheet below by 50 mm (2 in). Roll firmly into place.
   9. Seal around masonry reinforcing or ties and all penetrations with termination mastic.
   10. Continue the membrane into all openings in the wall, such as doors, windows, etc. and terminate at points that will prevent visibility from interior.
   11. Coordinate the installation of air and vapor barrier with roof installer to ensure continuity of membrane with rooftop air and vapor membrane.
   12. At end of working day seal top edge of air and vapor barrier to substrate with termination mastic.
   13. Do not allow the rubberized asphalt surface of the air and vapor barrier membrane to come in contact with polysulfide sealants, creosote, uncured coal tar products or EPDM.
   14. Do not expose air and vapor barrier membrane to sunlight for more than thirty days prior to enclosure.
   15. Inspect installation prior to enclosing and repair punctures, damaged areas and inadequately lapped seams with a patch of the membrane sized to extend 150 mm (6 in) in all directions from the perimeter of the affected area.

D. Application of Transition Membrane
   1. Prime substrate to receive transition membrane as required per manufacturers written instructions.
   2. Apply transition membrane with a minimum overlap of 75 mm (3 in.) onto each surface at all beams, columns and joints as indicated in detail drawings.
   3. Tie in to window and door frames, spandrel panels, roof and floor intersections and changes in substrate.
   4. Use pre-cut, easily handled lengths for each location.
   5. Remove silicone-coated release paper and position membrane flashing carefully before placing it against the surface.
   6. When properly positioned, place against surface by pressing firmly into place by hand roller.
   7. Overlap adjacent pieces 50 mm (2 in) and roll all seams with a hand roller.
   8. Seal top edge of flashing with termination mastic.
   9. When transition flashing is pre-installed prior to application of Fluid Applied Membrane, apply transition flashing as above. Spray or trowel a continuous uniform film of Fluid

Membrane at min. 60 mils (1.5 mm or .060 in) dry film thickness using multiple, overlapping passes, with a minimum overlap of 75 mm (3 in) onto transition flashing. For sill condition, spray or trowel Fluid Membrane onto pre-installed sill flashing and onto horizontal section of sill.

E. Application of Flexible Membrane Wall Flashing
   1. Prime substrate to receive wall flashing as required per manufacturers written instructions.
   2. Precut pieces of flashing to easily handled lengths for each location.
   3. Remove silicone-coated release paper and position flashing carefully before placing it against the surface.
   4. When properly positioned, place against surface by pressing firmly into place by hand roller. Fully adhere flashing to substrate to prevent water from migrating under flashing.
   5. Overlap adjacent pieces 50 mm (2 in) and roll all seams with a hand roller.
   6. Trim bottom edge 13 mm (1/2 in) back from exposed face of the wall. Flashing shall not be permanently exposed to sunlight.
   7. At heads, sills and all flashing terminations, turn up ends a minimum of 50 mm (2 in) and make careful folds to form an end dam, with the seams sealed.
   8. Seal top edge of flashing with termination mastic.
   9. Do not allow the rubberized asphalt surface of the flashing membrane to come in contact with poly-sulfide sealants, creosote, uncured coal tar products or EPDM.

3.04 PROTECTION AND CLEANING

A. Remoe any masking materials after installation. Clean any stains on materials that would be exposed in the completed work using procedures as recommended by manufacturer.

B. Perm-A-Barrier Wall Membrane is not suitable for permanent exposure and should be protected from the effects of sunlight.

C. Schedule work to ensure that the Wall Membrane system is covered as soon as possible after installation. Protect Wall Membrane system from damage during subsequent operations. If the Wall Membrane system cannot be covered within 30 days after installation, apply temporary UV protection such as dark plastic sheet or tarpaulins.

END OF SECTION

SECTION 07 1616 - CRYSTALLINE WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Crystalline waterproofing at locations of flooring systems.

1.02 RELATED REQUIREMENTS

A. Section 09 6500 - Resilient Flooring

B. Section 09 6813 - Tile Carpeting

1.03 REFERENCE STANDARDS

A. ASTM E-96 - Standard Test Method for Water Vapor Transmission of Materials

B. ASTM 1869- Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

C. ASTM F 2170- Standard Test Method for Determining Relative Humidity in Floor Slabs Using In Situ Probes

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Test data showing hydraulic permeability.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.

C. Specimen warranty.

D. Schedule of Values: Contractor to include crystalline waterproofing as a separate line item on the Schedule of Values.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Acceptable to manufacturer, with documented experience on at least five projects of similar nature within last five years.

B. Product shall be free of Volatile Organic Compounds (VOC's).

C. Product shall be USDA chemically acceptable as a coating for application to structural surfaces where there is a possibility of incidental food contact in establishments operating under the Federal Meat and Poultry Products Inspection Program.

D. Product shall be approved for use by The Regulatory Enforcement and Animal Care (REAC) division of the U.S. Dept. of Agriculture approved for use in all animal clinics and in holding and shelter facilities.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Take necessary precautions to keep cementitious materials dry.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results; do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's 20 year warrenty aginst damaging moisture and vapor migration, alkai and efflorescence. Warrenty shall cover 100% of the cost to repair or replace areas damaged including vinyl composition tile.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Crystalline Waterproofing:
   1. Bone Dry Pro Permanent Penetrating Concrete Sealer by Bone Dry Products, Inc. 6520 67th Street, Kenosha, WI 53142, Tel: 262-694-9748, E-mail: jim@bonedryproducts.com, Website: www.bonedryproducts.com.
   2. Or prior approved equal.

2.02 APPLICATIONS

A. All concrete surfaces to recieve glue down flooring.

B. All concrete surfaces to receive wood flooring.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

A. Install in strict accordance with manufacturer's instructions, maintain environmental conditions required and recommended by manufacturer, and keep a copy of manufacturer's instructions on site.

B. Coordinate installation with installation of products that must penetrate waterproofed surfaces.

C. Prevent excessive drying of surface.
   1. Cure waterproofing for at least three days, or length of time required by manufacturer, with water spray and adequate air circulation.
   2. Do not use chemical curing agents unless explicitly approved by waterproofing manufacturer.

D. Do not backfill, fill water or liquid holding structures, or apply finish coatings until time period recommended by manufacturer has passed.

3.03 PROTECTION

A. Protect from damage by weather; do not cover with impermeable (plastic) sheeting unless air circulation is provided.

B. Touch-up, repair or replace damaged waterproofing after Date of Substantial Completion.

END OF SECTION

SECTION 07 2100 - THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at cavity wall construction and at exterior applications, as indicated in drawings.

B. Batt insulation in wall construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

A. Section 07 5200 - Modified Bituminous Membrane Roofing: Installation requirements for board insulation over low slope roof deck specified in this section.

B. Section 07 8400 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.

1.03 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2016.

D. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2010.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

G. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2016.

H. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials

I. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies; 2011.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Provide data on product characteristics, performance criteria, product limitations, and accessories required for installation..

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

E. Installer Qualifications: All products listed in this section are to be installed by a single Installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.

F. Mock-Up: Provide a mock-up for evaluation by the Architect of surface preparation techniques and application workmanship.

1.05 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

B. Do not install joint sealants, joint tapes, transition tape, or flashing materials on to dirty board insulation.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation Over Metal Stud Framed Walls, Continuous: Polyisocyanurate board.

B. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

2.02 FOAM BOARD INSULATION MATERIALS

A. Polyisocyanurate (ISO) Board Insulation with Facers Both Sides: Rigid cellular foam, complying with ASTM C1289.
   1. Classifications:
      a. Type II:
         1) Class 2 - Faced with coated polymer bonded glass fiber mat facers on both major surfaces of core foam.
         2) Compressive Strength: Class 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
         3) Thermal Resistance, R-value: At 1-1/2 inch thick; Class 1, Grades 1-2-3, 8.4 (1.48) at 75 degrees F.
   2. Rigid insulation layer thickness shall be as indicated, Polyisocyanurate-Foam Board Insulation, at locations as indicated on drawings, to achieve an average R value of R-6. Insulation may be applied in one layer using 4' x 4' or 4' x 8' boards. This insulation must have a minimum compressive strength of 25 psi.
   3. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   4. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   5. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
   6. Board Thickness: As indicated on drawings.
   7. Board Edges: Shiplap on long edges.
   8. Vapor Permeance: 0.03 perm, maximum, at 1 inch thickness, and when tested in accorance with ASTM E96/E96M, desiccant method.
   9. Manufacturers:
      a. Basis of Design: Rmax Inc; ECOMAXci: www.rmax.com/#sle.
         1) Tape for Insulation Joints: R-Seal 3000
         2) Flashing for Windows, Doors, & Penetrations: R-Seal 6000
      b. Dow Chemical Company; THERMAX Sheathing: www.dow.com/#sle.
      c. Or prior approved equal.
   10. Substitutions: See Section 01 6000 - Product Requirements.

2.03 BATT INSULATION MATERIALS

A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.

B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
   4. Thermal Resistance: R-value of 19 minimum at exterior walls.
   5. Thickness: As indicated on drawings, unless otherwise required to meet required R-value.
   6. Manufacturers:
      a. CertainTeed Corporation: www.certainteed.com.
      b. Johns Manville: www.jm.com.
      c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
   7. Substitutions: See Section 01 6000 - Product Requirements.

C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   2. Manufacturers:
      a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com/#sle.
      b. Knauf Insulation; EcoBatt Insulation: www.knaufinsulation.com/#sle.
      c. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com/#sle.

2.04 ACCESSORIES

A. Insulation Joint and Flashing Components:
   1. General - Joint Treatment and Flashing Components:
      a. Material Standards: As approved by Manufacturer of Polyisocyanurate (ISO) Board Insulation
         1) AAMA 711: For self-adhered flashing and joint materials
         2) AAMA 714: For liquid applied flashing and joint materials.
      b. Liquid Flashing for Stationary Joint Treatment of Faced Polyisocyanurate Insulation:
         1) Rmax R-SEAL 200 LF with Rmax Inc; ECOMAXci FR.
         2) LiquidArmor CM Flashing and Sealant with DOW THERMAX (ci) Exterior Insulation
      c. Joint Sealant Tape for Stationary Joint Treatment ECOMAXci FR
         1) Rmax R-SEAL 3000 tape
      d. Flashing and Transition Tape for Joints Subject to Movement, at fastener penetrations, and openings and transition to other building materials ECOMAXci FR:
         1) Rmax R-SEAL 6000 tape

B. Tape joints of rigid insulation in accordance with insulation manufacturers' instructions.

C. Fasteners for Fastening Polyisocyanurate Wall Insulation to metal stud framed wall surfaces:
   1. Self-drilling ceramic coated screw.
      a. Product: Rodenhouse Grip-Deck screws or comparable products.
         1) Large-diameter, low profile pancake head, case hardened and tempered carbon steel, epoxy e-coat to comply with governing standards
            (a) Product: TurFast; Nailboard Fasteners or comparable product.Thread Style and Point:
               (1) SIPHD: Heavy-duty. Drill point for thick steel member applications.
      b. Washers: Self-sealing for use with Self-drilling screws:
         1) Self-Sealing 2 inch diameter polymer washer, UV stabalized, tested, and approved to provide air and water resistive seal, in combination with compatible self drilling screw
         2) Product: Rodenhouse Thermal-Grip ci prong washer or comparable product.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT EXTERIOR WALLS

A. Adhere 6 inches (152 mm) wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints between sheets.

B. Install rigid insulation directly to steel studs or exterior grade sheathing at 16 inches (406 mm) on center with manufacturer recommended mechanical fasteners, and tape joints with

manufacturer's minimum 4 inches (102 mm) wide sealant tape; comply with ASTM E2357, or manufacturer's liquid applied flashing & sealant.

C. Install boards horizontally on walls.
   1. Install in running bond pattern.
   2. Butt edges and ends tightly to adjacent boards and protrusions.
   3. Follow manufacturer's recomended installation details at expansion joints.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

E. Place 6 inches (152 mm) wide Manufacturer's required tape or liquid sealant at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames, and tape seal or liquid seal in place to ensure continuity of vapor retarder and air seal.

F. Tape or use liquid seal at insulation board joints.

G. Tape or use liquid seal at locations of all penetrations to attach furring strips thru insulation to steel studs.

3.03 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. Tape insulation batts in place.

F. Retain insulation batts in place with spindle fasteners at 12 inches (305 mm) on center. where there is no finish on the insulation to hold it in place.

3.04 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 2726 - FLUID APPLIED NON-PERMEABLE AIR BARRIER

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. General Conditions, Supplementary Conditions, Instructions to Bidders and Division One General Requirements shall be read in conjunction with and govern this section.

1.02 DESCRIPTION

A. Supply labor, materials and equipment to complete the Work as shown on the Drawings and as specified herein to bridge and seal the following air leakage pathways and gaps:
   1. Connections of the walls to the roof air barrier.
   2. Connections of the walls to the foundations.
   3. Seismic and expansion joints.
   4. Openings and penetrations of window and door frames, store front, curtain wall.
   5. Piping, conduit, duct and similar penetrations.
   6. Masonry ties, screws, bolts and similar penetrations.
   7. All other air leakage pathways in the building envelope.

B. Materials and installation methods of the primary air/vapor barrier membrane system and accessories.

C. Materials and installation methods of through-wall flashing membranes.

1.03 REFERENCES

A. The following standards are applicable to this section:
   1. ASTM E 2178: Standard Test Method for Air Permeance of Building Materials.
   2. ASTM E 283: Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
   3. E 1677 Specification for Air Retarder (AR) Material or System for Low-Rise Framed Building Walls
   4. ASTM E 330: Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
   5. ASTM E 331: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
   6. ASTM E 96: Water Vapor Transmission of Materials.
   7. CGSB 37-GP-56M: Membrane, Modified, Bituminous, Prefabricated, and Reinforced.
   8. AMMA 2400: Standard Practice for Installation of Windows with a Mounting Flange in Stud Frame Construction.
   9. ASTM E 2112: Standard Practice for Installation of Exterior Windows, Doors and Skylights.
   10. ASTM D 5590: Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

1.04 SUBMITTALS

A. Submit documentation from an approved independent testing laboratory certifying the air leakage and vapor permeance rates of the air barrier membranes, including primary membrane and transition sheets, exceed the requirements of the Energy Code and in accordance with ASTM E 2178.
   1. Test report submittals shall include test results on porous substrate and include sustained wind load and gust load air leakage results.

B. Submit manufacturers' current product data sheets for the air barrier membrane system.

C. Submit manufacturer's installation Instructions.

D. Submit document stating the applicator of the primary air/vapor barrier membranes specified in this section is qualified by the manufacturer as suitable for the execution of the Work.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with manufacturer's written instructions and this specification.

B. Maintain one copy of manufacturer's written instructions on site.

C. Allow access to Work site by the air barrier membrane manufacturer's representative.

D. Components used shall be sourced from one manufacturer, including sheet membrane, air barrier sealants, primers, mastics, and adhesives.

E. Single-Source Responsibility:
   1. Obtain air barrier materials from a single manufacturer regularly engaged in manufacturing the product.
   2. Provide products which comply with all federal, state and local regulations controlling use of volatile organic compounds (VOCs).

1.06 MOCK-UP

A. Provide mock-up of air/vapor barrier materials under provisions of Section 01 3300 Submittls.

B. Where directed by architect, construct typical exterior wall panel, 6 foot long by 6 foot wide, incorporating substrate, window frame, attachment of insulation and showing air barrier membrane application details.

C. Allow 48 hours for observation of mock-up by architect before proceeding with air barrier work. Mock-up may remain as part of the Work.

1.07 PRE-INSTALLATION CONFERENCE

A. Contractor shall convene week prior to commencing Work of this section.

B. Ensure all contractors responsible for creating a continuous plane of air tightness are present.

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to current Product MSDS for proper storage and handling.

B. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

C. Store role materials on end in original packaging. Protect rolls from direct sunlight until ready for use.

D. Store air barrier membranes, adhesives and primers at temperatures of 40 degrees F and rising.

E. Keep solvent away from open flame or excessive heat.

F. Wasted Management and Disposal
   1. Separate and recycle waste materials in accordance with Section 01 7419 - Construction Waste Management and Disposal.

G. Contractor to verify compliance for Volatile Organic Compounds (VOC) limitations of products to comply with all federal, state and local regulations controlling use of volatile organic compounds (VOCs).

1.09 COORDINATION

A. Ensure continuity of the air seal throughout the scope of this section.

1.10 WARRANTY

A. Provide manufacturer's standard 10-year material warranty.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Air/vapor barrier membrane components and accessories must be obtained as a single-source from the membrane manufacturer to ensure total system compatibility and integrity.
   1. Acceptable Manufacturers:
      a. Henry Company

999 N Sepulveda Blvd, Suite 800
El Segundo, CA 90245
(800) 598-7663
www.Henry.com

b. Grace Construction Products
c. **Carlisle Coatings & Waterproofing - Barriseal R**

2.02 MEMBRANES (BASIS-OF-DESIGN)

A. Primary liquid air/vapor barrier membrane for temperatures above 40 degrees F shall be Air-Bloc 32MR manufactured by Henry, Perm-A-Barrier Liquid manufactured by Grace Construction Products, or approved equal; a one component elastomeric membrane, trowel or spray applied, compatibility with substrates, transition membranes and insulation. Membrane shall have the following physical properties:
1. Meets the air leakage requirements of the Massachusetts Commercial Energy Code (780 CMR, Ch. 13) Energy Conservation Requirements for the Building Envelope,
2. Air permeability: 0.00012 CFM/ft2 @ 1.6 lbs/ft2 to ASTM E 2178 and ASTM E 283 and have no increased air leakage when subjected to a sustained wind load of 10.5 lbs/ft2 for 1 hour and gust wind load pressure of 62.8 lbs/ft2 for 10 seconds when tested at 1.6 lbs/ft2 to ASTM E 331,
3. Rating 0 -No fungal growth as tested to ASTM D 5339,
4. Water vapor permeance: 0.08 perms to ASTM E 96,
5. VOC Content: No appreciable VOC (less then 100g/L),
6. Elastic Recovery: 90% to CAN/CGSB 37.58M86,
7. Meets CAN/CGSB-51-33 Type I Water Vapor Permeance requirements

B. Self-adhering transition membrane shall be Blueskin SA, LT, or HT manufactured by Henry, Perm-A-Barrier Detail Membrane manufactured by Grace Construction Products; an SBS modified bitumen, self-adhering sheet membrane complete with a blue engineered thermoplastic film. Membrane shall have the following physical properties:
1. Air leakage: <0.0001 CFM/ft² @1.6 lbs/ft2 to ASTM E2178,
2. Vapor permeance: 0.03 perms to ASTM E 96,
3. Membrane Thickness: 0.0394 inches (40 mils),
4. Low temperature flexibility: -22 degrees F to CGSB 37-GP-56M,
5. Elongation: 200% to ASTM D412-modifed

C. Through-wall flashing membrane (Self-Adhering) shall be Blueskin TWF manufactured by Henry, or Perm-A-Barrier Wall Flashing manufactured by Grace Construction Products ; an SBS modified bitumen, self-adhering sheet membrane complete with a yellow engineered thermoplastic film. Membrane shall have the following physical properties:
1. Membrane Thickness: 0.0394 inches (40 mils),
2. Film Thickness: 4.0 mils,
3. Flow (ASTM D5147): Pass @ 212 degrees F,
4. Puncture Resistance: 134 lbf to ASTM E 154,
5. Tensile Strength (film): 5000 psi minimum ASTM D 882,
6. Tear Resistance: 45lbs.-MD, 17lbs.-CD to ASTM D1004,
7. Low temperature flexibility: -22 degrees F to CGSB 37-GP-56M

2.03 ADHESIVE AND PRIMERS

A. Primer for self-adhering membranes at temperatures above 25 degrees F shall be Aquatacä Primer manufactured by Henry, or Perm-A-Barrier primer manufactured by Grace Construction Products; a polymer emulsion based adhesive, quick setting. Primer shall have the following physical properties:
1. Color: Aqua,
2. Weight: 8.3 lbs/gal,
3. Solids by weight: 53%,
4. Water based, no solvent odors,
5. Drying time (initial set): 30 minutes at 50% RH and 70 degrees F

B. Adhesive for self-adhering membranes at all temperatures shall be Blueskin Adhesive manufactured by Henry, or Perm-A-Barrier adhesive approved by Grace Construction Products, a synthetic rubber based adhesive, quick setting, having the following physical properties:
   1. Color: Blue,
   2. Weight: 6 lbs/gal,
   3. Solids by weight: 35%,
   4. Drying time (initial set): 30 minutes

C. Adhesive with low VOC content for self-adhering membranes at all temperatures shall be Blueskin LVC Adhesive manufactured by Henry, or approved adhesive manufactured by Grace Construction Products; a synthetic rubber based adhesive, quick setting, having the following physical properties:
   1. Color: Blue,
   2. VOC: <240 g/L,
   3. Solids by weight: 40%,
   4. Drying time (initial set): 30 minutes

2.04 JOINT TREATMENT, PENETRATION & TERMINATION SEALANT

A. Joint Treatment, penetration and termination Sealant shall be HE925 BES Sealant manufactured by Henry; a moisture cure, medium modulus polymer modified sealing compound having the following physical properties:
   1. Compatible with sheet air barrier, roofing and waterproofing membranes and substrate,
   2. Complies with Fed. Spec. TT-S-00230C, Type II, Class A,
   3. Complies with ASTM C 920, Type S, Grade NS, Class 25,
   4. Elongation: 450 – 550%,
   5. Remains flexible with aging,
   6. Seals construction joints up to 1 inch wide

B. Alternate joint treatment fabric: HE 183 yellow open weave glass fabric or approved equal.

2.05 INSULATION ADHESIVE

A. Insulation adhesive shall be Air-Bloc 21 Insulation Adhesive manufactured by Henry; a synthetic, trowel applied, rubber based adhesive, having the following physical properties:
   1. Compatibility: With air barrier membrane, substrate and insulation,
   2. Air leakage: 0.0026 CFM/ft2 @ 1.6 lbs/ft2 to ASTM E283,
   3. Water vapor permeance: 0.03 perms to ASTM E96,
   4. Long term flexibility: CGSB 71-GP-24M

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the Work of this section. Notify architect in writing of any discrepancies. Commencement of the work or any parts thereof shall mean acceptance of the prepared substrates.

B. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill spalled areas in substrate to provide an even plane. Strike masonry joints flush.

C. Where curing compounds are used they must be clear resin based without oil, wax or pigments.

D. Do not proceed with application of air barrier membrane when rain is expected within 24 hours.

E. Condition materials to room temperature prior to application to facilitate handling.

3.02 SURFACE PREPARATION

A. Water Based Elastomeric Emulsion Air Barrier Membrane: liquid applied water based air barrier membrane may be applied to green concrete 16 hours after forms are removed.

B. Ensure all preparatory Work is complete prior to applying primary air barrier membrane.

C. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing and fastened into solid backing.

3.03 INSTALLTION OF AIR VAPOR BARRIER SYSTEM

A. JOINT TREATMENT
   1. Seal joints ¼ inch and less between panels of exterior grade gypsum sheathing, plywood, OSB or cementitious panels with joint treatment sealant.
      a. Fill joint between sheathing with approved joint treatment sealant ensuring contact with all edges of sheathing board. Strike flush any excess sealant over joint layer to form a continuous layer over the joint.
      b. Seal gaps and voids or irregular joints greater than ¼ inch between panels of exterior grade gypsum, exterior grade gypsum sheathing, plywood, OSB or cementitious panels with a strip of self-adhering air/vapor barrier transition membrane lapped a minimum of 1-1/2 inches on both sides of the joint.
         1) Prime surfaces as per manufacturers' instructions and allow to dry.
         2) Align and position self-adhering air/vapor barrier transition membrane, remove protective film and press firmly into place. Ensure minimum 2 inches overlap at all end and side laps of membrane.
         3) Roll all laps and membrane with a counter top roller to ensure seal.
      c. Alternately, joints not exceeding 1/8 inch can be sealed with yellow open weave glass fabric.
         1) Apply yellow open weave glass fabric centered over joint followed by a 1/8 inch (120mils) thick trowel application of air/vapor barrier membrane.
         2) Allow to dry prior to application of primary air/vapor barrier membrane.

B. INSIDE AND OUTSIDE CORNERS
   1. Seal inside and outside corners of sheathing boards with a strip of self-adhering air/vapor barrier transition membrane extending a minimum of 3 inches on either side of the corner detail.
      a. Prime surfaces as per manufacturers' instructions and allow to dry.
      b. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 2 inches overlap at all end and side laps of membrane.
      c. Roll all laps and membrane with a counter top roller to ensure seal.

C. CRACK TREATMENT – MASONRY AND CONCRETE
   1. Seal cracks over 1/16 inches in masonry and concrete with a strip of self-adhering air/vapor barrier transition membrane lapped a minimum of 1 1/2 inches on both sides of the crack.
      a. Prime surfaces as per manufacturers' instructions and allow to dry.
      b. Align and position self-adhering air/vapor barrier transition membrane, remove protective film and press firmly into place. Ensure minimum 2 inches overlap at all end and side laps of membrane.
      c. Roll all laps and membrane with a counter top roller to ensure seal.
      d. Alternately, static cracks 1/16 inch to 1/8 inch can be sealed with primary air/vapor barrier membrane.
         1) Fill crack with primary air barrier membrane.
         2) Allow to dry prior to application of primary air/vapor barrier membrane.

D. TRANSITION AREAS
   1. Tie-in to structural beams, columns, floor slabs and intermittent floors, parapet curbs, foundation walls, roofing systems and at the interface of dissimilar materials as indicated in drawings with self-adhering air/vapor barrier transition membrane.
      a. Prime surfaces as per manufacturers' instructions and allow to dry.
      b. Align and position self-adhering air/vapor barrier transition membrane, remove protective film and press firmly into place. Provide minimum 3 inch lap to all substrates.

c. Ensure minimum 2 inch overlap at all end and side laps of membrane.
d. Roll all laps and membrane with a counter top roller to ensure seal.

E. WINDOWS AND ROUGH OPENINGS
1. Wrap rough openings with self-adhering membrane as detailed.
a. Prime surfaces as per manufacturers' instructions and allow to dry.
b. Align and position self-adhering air/vapor barrier transition membrane, remove protective film and press firmly into place. Ensure minimum 2 inch overlap at all end and side laps of membrane.
c. Roll all laps and membrane with a counter top roller to ensure seal.

F. THROUGH-WALL FLASHING MEMBRANE
1. Apply through-wall flashing membrane along the base of masonry veneer walls and over shelf angles as detailed.
a. Prime surfaces and allow to dry, press membrane firmly into place, over lap minimum 2 inches at all end and side laps. Promptly roll all laps and membrane to ensure the seal.
b. Applications shall form a continuous flashing membrane and shall extend up a minimum of 8 inches up the back-up wall.
c. Seal the top edge of the membrane where it meets the substrate using termination sealant. Trowel-apply a feathered edge to seal termination to shed water.
d. Install through-wall flashing membrane and extend 1/2 inch from outside edge of veneer. Provide "end dam" flashing as detailed.

G. PRIMARY AIR/VAPOR BARRIER
1. Apply by spray or flat trowel a complete and continuous unbroken film of liquid air/vapor and rain barrier membrane.
a. For temperatures above 40 degrees F and rising, apply one component water based elastomeric emulsion air/vapor barrier membrane at a rate of 20 sq.ft/gallon to a uniform wet film thickness of 75 mils for smooth surfaces depending upon surface texture and porosity. For rough surfaces, apply elastomeric emulsion air/vapor barrier membrane at a rate of 14 sq.ft/gallon to a uniform wet film thickness of 110 mils depending upon surface texture and porosity.
b. Spray-apply or trowel around all projections and penetrations ensuring a complete and continuous air barrier membrane. Lap liquid applied membrane 1 inch over self-adhering membranes to seal leading edge.
c. Allow air barrier membrane to dry as per manufacturers recommendations prior to placement of insulating materials.

3.04 APPLICATION OF TERMINATION SEALANT

A. Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, duct work, electrical and other apparatus extending through the primary water resistive air barrier membrane and around the perimeter edge of membrane terminations at window and door frames with specified termination sealant.

3.05 FIELD QUALITY CONTROL

A. Make notification when sections of Work are complete to allow review prior to covering air barrier system.

3.06 INSTALLATION OF INSULATION

A. Apply insulation adhesive in a serpentine pattern over the air barrier membrane.
1. Dab Method: Apply walnut-sized dabs of insulation adhesive spaced 6 inches on center to substrate. Apply insulation using sufficient hand pressure to compress dabs up to 2 inches in diameter.
2. Bead Method: Apply ¼ inch beads 6 inches on center in a serpentine pattern.

B. Immediately embed insulation into the adhesive and press firmly into place to ensure full contact. Apply additional adhesive if allowed to skin over.

3.07 PROTECTION

A. Damp substrates must not be inhibited from drying out. Do not expose the backside of the substrate to moisture or rain.

B. Cap and protect exposed back-up walls against wet weather conditions during and after application of membrane. Drying time varies depending on temperature and relative humidity. Protect air barrier Work against wet weather conditions for a minimum of 24 hours.

C. Air barrier membranes are not designed for permanent exposure. Good practice calls for covering as soon as possible. Special consideration must be given to the exposed un-insulated membrane during winter months of construction so as to avoid the risk of condensation.

END OF SECTION

SECTION 07 4213 - METAL WALL AND SOFFIT PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured metal panels for walls and soffits and related flashings and accessory components.

B. Concealed fastener single skin metal wall panels installed using the back ventilated rainscreen design principle.

C. Concealed fastener, field assembled, insulated metal wall panels with liner panels.

D. Accessoried including fasteners, perimeter trim and penetration treatments.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Wall panel substrate.

B. Section 07 9200 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.03 REFERENCE STANDARDS

A. ASTM A240; Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

C. ASTM A666; Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

D. ASTM A792; Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

E. ASTM B209; Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

F. ASTM C612; Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

G. ASTM C645; Standard Test Method for Nonstructural Steel Framing Members.

H. ASTM D2244; Standard practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

I. ASTM D4214; Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films

J. ASTM E283; Standard Test Method for determining Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors under Specified Pressure Differences across the Specimen.

K. ASTM E331; Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

L. ASTM E1592; Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.04 DESIGN REQUIREMENTS

A. Components: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with International Building Code, 2021 code. Design pressure of, as required per code lb/sq ft (____ kPa).

B. Maximum Allowable Deflection of Panel: 1/90 of span.

C. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement within system; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.

D. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.

E. Water Penetration under Static Pressure: Provide metal wall panel systems designed to resist penetration of water under static pressure. Testing shall be based on ASTM E331. Wall panels when tested shall have no water leakage at 6 pounds per square foot.

F. Air Infiltration: Provide metal wall panel assemblies designed to resist air infiltration. Testing shall be done based on ASTM E283. Wall panels when tested shall have a maximum air leakage of 0.01 cfm per square feet of fixed wall area at a minimum static air-pressure differential of 1.57 foot pounds per square foot.

1.05 SUBMITTALS

A. Shop Drawings: Submit detailed drawings showing the following:
   1. Profile
   2. Gauge of panel
   3. Location, layout and dimensions of panels
   4. Location and type of fasteners
   5. Shape and method of attachment of all trim
   6. Locations and type of sealants
   7. Installation sequence.
   8. Other details as may be required for a weathertight installation

B. Samples: Submit two samples of each panel type, 6 inch by 6 inch in size, illustrating finish color, sheen, and texture.

C. Manufacturer's Qualification Statement.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of experience.

1.07 MOCK-UP

A. Construct mock-up, 6 feet (____ m) long by 6 feet (____ m) wide; include panel and soffit system, glazing, attachments to building frame, associated vapor retarder and air seal materials, weep drainage system, sealants and seals, related insulation in mock-up.

B. Locate where directed by Architect.

C. Pre-installation meeting: Conduct a pre-installation meeting at the job site attended by Owner, Architect, Manufacturer’s Technical Representative, Panel Installer, and Contractors of related trades. Coordinate structural support requirements in relation to wall panel system, installation of any separate air/water barriers, treatment of fenestration, and other requirements specific to the project

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.

C. Prevent contact with materials that may cause discoloration or staining of products.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Flush Metal Wall and Soffit Panel
   1. Correct defective work within a five year period after Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.

2. Correct defective work within a five year period after Date of Substantial Completion, including defects in water tightness and integrity of seals.
3. Finish Warranty: Standard form in which manufacturer agrees to repair or replace metal panels that evidence deterioration of fluoropolymer finish, including flaking or peeling from approved primed metal substrate, chalk in excess of 8 when tested in accordance with ASTM D4214, Method A, and /or color fading in excess of 5 deltaE Hunter units on panels when tested in accordance with ASTM D2244.
    a. Warranty Period: Twenty (20) years from date Substantial Completion, or 20 years.

C. Wood Look Wall and Soffit Panel
1. Provide a written guarantee, signed and issued in the name of the owner, covering the metal cladding/cladding material for 15 (fifteen) years from the date of Substantial Completion.
2. The manufacturer's warranty is limited to replacement of defective material only, rather than installation of the same. Faulty installation shall be corrected by the installing contractor. The warranty required herein is the sole remedy against the manufacturer and there are no other implied warranties. In any event, the manufacturer shall not be liable for incidentals or consequential damages.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Wall and Soffit Panels (**MP-2**) - Concealed Fasteners:
1. Basis of Design: Petersen Aluminum Corporation; Flush Wall Panels: www.pac-clad.com/#sle.

B. Wood Look Metal Wall and Soffit Panels (**FMP-01**) - Concealed Fasteners:
1. Basis of Design: Longboard Wood Grain Aluminum Panels, 6" V-Groove, manufactured by Mayne Coatings Corp.; www.longboardproducts.com.
    a. Material: Extruded Aluminum 6063-T5
    b. Thickness: 1/16-inch (1.57mm) base metal thickness
    c. Profile: 6-inch V-Groove X 24 ft plank
    d. Accessories: Provide accessories in same finishes as cladding as necessary for a fully finished and functional system
        1) 3" Starter Strip
        2) 5/8" Starter J-Track,
        3) 5/8" J-Track
        4) 5/8" Two Piece J-Track
        5) 1 3/8" Two Piece J-Track
        6) 3/4" Inside Corner
        7) 1" Outside Corner
        8) 2" Corner Set
        9) 3/16" Outside Corner
        10) 5/8" Termination Set
        11) 1 3/8" Termination Set
        12) 1 3/8" Compression Joint
        13) 1/2" Flat Reveal
        14) 3/4" U-Reveal Set
        15) 1 1/2" U-Reveal Set
        16) 1 1/2" Flat Reveal Set
        17) 3/4" T & G U-Reveal
        18) 1 1/2" T & G U-Reveal
        19) 1/2" T & G Flat Reveal
        20) 2" Offset Flat Reveal
        21) Plank Clips: 316 Stainless Steel Quick Screen Clips

C. Other Acceptable Manufacturers:
1. ATAS International, Inc: www.atas.com/#sle

2. Berridge Manufacturing Company: www.berridge.com/#sle
3. Centria: www.centria.com/#sle
4. McElroy Metal: www.mcelroymetal.com/#sle.
5. Morin Corporation: www.morincorp.com/#sle
6. Petersen Aluminum Corporation: www.pac-clad.com/#sle.
7. Sheffield Metals International: www.sheffieldmetals/#sle

2.02 WALL PANEL MATERIALS

A. Steel (MP-02):
   1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792, Class AZ50 coating designation, Grade 40.
   2. Gauge: 22

2.03 ACCESSORIES

A. Wall panel accessories: Provide accessories as required for a complete installation. Accessories shall be as indicated on approved shop drawings and per manufacturer's approved standard details. Match material and finish of metal wall panels.
   1. Concealed Clips: 18 gauge; Zinc-Coated (Galvanized) Steel Sheet: ASTM A653, G90 coating designation

B. Trim:
   1. Fabricate trim from same material and material thickness as wall panels. Finish to match metal wall panels.
   2. Locations include, but are not limited to the following: Drips, sills, jambs, corners, framed openings, parapet caps, reveals and fillers.

C. Metal Framing:
   1. General: ASTM C645, cold-formed metallic-coated steel sheet, ASTM A653, G40 hot-dip galvanized.
   2. Hat-Shaped, Rigid Furring Channels:
      a. Gauge: 16 gauge.
      b. Depth: As indicated on Drawings.
   3. Cold-Rolled Furring Channels: Minimum 1/2-inch wide flange.
      a. Gauge: 16 gauge.
      b. Depth: As indicated on Drawings.

D. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

2.04 FABRICATION

A. Metal wall panels and liner panels shall be formed to lap and interconnect with edges of adjacent panels which are then mechanically attached through panel to supports using concealed fasteners.

B. Panels shall be factory formed. Field formed panels are not acceptable.

C. Trim Accessories: Fabricate steel trim accessories to comply with recommendations outlined in SMACNA's "Architectural Sheet Metal Manual".

D. Trim Accessories: Provide manufacturer's standard extruded aluminum trim.

2.05 FINISHES

A. Steel:
   1. Finish and Color:
      a. Color:
         1) MP-02 Flush Wall Panels: Color as selected by Architect from Manufacturer's Full Range.
         2) Wood Look Soffit Panel: Wood Grain Color in as selected by Architect from Manufacturer's full range
      b. Finish System:

c. 1.5 mil. Fluropolymer (PVDF) Three Coat system: 0.2 mil primer with 0.8 mil Kynar 500 (70 percent) METALLIC color coat and .5 mil clear coat.

2.06 MANUFACTURED METAL PANELS

A. Panel System: Factory fabricated prefinished metal panel system, site assembled.
   1. Provide exterior panels, soffit panels, and subgirt framing assembly.
   2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
   3. Design Pressure: In accordance with applicable codes.
   4. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
   5. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
   6. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
   7. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
   8. Corners: Factory-fabricated in one continuous piece with minimum 2 inch (51 mm) returns.
   9. Exterior Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over manufacturer's recommended primer.
   10. Exterior Finish: Wood Look Panel: Panel manufacturer's standard polyurethan coating with ink based wood grain patterns sublimated into the based powder, top coat over manufacturer's recommended primer.
      a. Alluminate Premium Wood Finish: Wood Grain Color as selected by Architect from Manufacturer's full range.

B. Wall and Soffit Panels (**MP-02**):
   1. Profile: 12 inch flush panel, unless otherwise indicated in Drawings.
   2. Installation: As Indicated in Drawings
   3. Material: Precoated steel sheet, 22 gage, 0.0299 inch (0.76 mm) minimum thickness.
   4. Color: As selected by Architect from manufacturer's full line

C. Wall and Soffit Panels (**Wood Look Metal**):
   1. Profile: 6" V-Groove Profile.
   2. Material: Precoated steel sheet, 22 gage, 0.0299 inch (0.76 mm) minimum thickness.
   3. Color: Wood Grain Color as selected by Architect from Manufacturer's full range.

D. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

E. Anchors: Galvanized steel, Stainless steel, or type as recommended by panel manufacturer..

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building framing members are ready to receive panels.

B. Verify that water-resistive barrier has been installed over substrate completely and correctly.

C. Provide field measurements to manufacturer as required to achieve proper fit of the metal wall panels to building envelope. Measurements shall be provided in a timely manner so that there is no impact to construction or manufacturing schedule.

D. Supporting Steel: All structural supports required for installation of panels shall be by others. Support members shall be installed within the following tolerances:
   1. Plus or minus 1/8 inch in 5 feet in any direction along plane of framing.
   2. Plus or minus ¼ inch cumulative in 20 feet in any direction along plane of framing.
   3. Plus or minus ½ inch from framing plane on any elevation.
   4. Plumb or level within 1/8 inch at all changes of transverse for performed corner panel applications.

5. Verify that bearing support has been provided behind vertical joints of horizontal panel systems and vertical joints of horizontal panel systems. Width of support shall be as recommended by manufacturer.

E. Examine individual panels upon removing from the bundle; notify manufacturer of panel defects. Do not install defective panels.

3.02 INSTALLATION

A. Install panels on walls and soffits in accordance with manufacturer's instructions.

B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.

C. Fasten panels to structural supports; aligned, level, and plumb and per layout indicated on approved shop drawings.

D. Cutting and fitting of panels shall be neat, square, and true. Torch cutting is prohibited.

E. Locate Joints as indicated on plan and to align with other building elements.

F. Use concealed fasteners unless otherwise approved by Architect.

G. Place trim and trim fasteners only as indicated per details on the approved shop drawings.

H. Apply sealant tape at trim, per manufacturer’s details and approved shop drawings, for weathertight installation.

I. Clean and prime surfaces to review exterior exposed sealants in accordance with sealant manufacturer’s recommendations.

J. Follow sealant manufacturer’s recommendations for joint width-to-depth ratio, application temperature range, size and type of backer rod, and compatibility of materials for adhesion.

3.03 INSTALLATION OF METAL T&G CLADDING (WOOD LOOK SOFFIT PANELS)

A. Install cladding and components in accordance with manufacturer's written instructions and shop drawings, including product technical bulletins, datasheets and install videos.

B. Install all cladding planks using Quick-Screen Clips in accordance with the manufacturer's written instructions, technical bulletins, datasheets and install videos to not restrict thermal movement at specified o.c. spacings. Install screws in pre-punched holes. Install one (1) hard-fastened screw per plank, directly through the plank flange to prevent plank migration. All fasteners should penetrate into solid, secure framing or blocking.

C. Install components in accordance with the manufacturer's written instructions and shop drawings, including technical bulletins, datasheets and install videos with positive anchorage to building and provide for thermal movement.

D. Install screw fasteners using power tools having controlled torque adjusted to compress Quick-Screen Clips tight without damage or deformation of the Quick-Screen Clips, screw heads, screw threads or cladding.

E. Hard-fasten any and all butt-joints into solid secure framing or blocking, to maintain tight fitting hairline joints. Never exceed one (1) hard-fastener per plank, all other attachment points to use Quick-Screen Clips to not restrict thermal movement.

F. Do not install damaged panels; repair or replace as required.

3.04 TOLERANCES

A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch (1.6 mm).

B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch (6.4 mm).

3.05 CLEANING

A. Remove protective film immediately after installation.

B. Remove site cuttings from finish surfaces.

C. Touch-up, repair or replace metal panels and trim that have been damaged.

D. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

E. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION

SECTION 07 4214 - METAL COMPOSITE WALL PANELS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes metal composite material wall panels at cornice and soffit.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, metal composite material panel Installer, structural-support Installer, and installers whose work interfaces with or affects metal composite material panels, including installers of doors, windows, and louvers.
   2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   3. Review methods and procedures related to metal composite material panel installation, including manufacturer's written instructions.
   4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
   5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal composite material panels.
   6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
   7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
   8. Review procedures for repair of panels damaged after installation.
   9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:
   1. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
   2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: For each type of metal composite material panel indicated with factory-applied color finishes.
   1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
   1. Metal Composite Material Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal composite material panel accessories.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal composite material panels to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Build mockup of typical metal composite material panel assembly as directed by Architect, including corner, soffits, supports, attachments, and accessories.
   2. Water-Spray Test: Conduct water-spray test of mockup of metal composite material panel assembly, testing for water penetration according to AAMA 501.2.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal composite material panels for protection during transportation and handling.

B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal composite material panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.09 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including rupturing, cracking, or puncturing.
      b. Deterioration of metals and other materials beyond normal weathering.
   2. Warranty Period: Ten (10) years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:
1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 160 deg F, material surfaces.

E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.02 METAL COMPOSITE MATERIAL WALL PANELS

A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.
1. Basis-of-Design Product: Pac-Clad PAC 3000-RS Composite Wall Panel
a. Series 40 - Rainscreen by Alusystems (Alpolic or Reynobond): www.alusystems.com
b. CENTRIA Architectural Systems; Formabond II 4 mm Wall System.
c. Firestone Metal Products, LLC; UNA-FAB Series S1200.
d. Or approved equal.

B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch- (0.50-mm-) thick, coil-coated aluminum sheet facings.
1. Panel Thickness varies, refer to Drawings. Design intent is that panels taper with different thicknesses at each corner, refer to Drawings for individual panel configurations and thicknesses.
2. Core: Extruded thermoplastic core.
3. Exterior Finish: FEVE fluoropolymer or PVDF-based resin meeting or exceeding AAMA 2605 testing for durability.
a. Basis of Design Color:
1) Color: As selected by Architect from manufacturer's full range
b. Performance requirements:
1) Humidity resistance: No formation of blisters when subjected to condensing water fog at 100 percent relative humidity and 100 degree Fahrenheit for 3000 hours, tested to D2247.
2) Salt spray resistance: Expose of coating system to 3000 hours, using 5 percent NaCl solution:

(a) Corrosion creepage from scribe line: Maximum 1/8 inch.
(b) Minimum blister rating: 8 within test specimen field.

3) Outdoor weather exposure:
(a) Ten year exposure at 45 degree angle facing south Florida exposure.
(b) Maximum color change: 5 Delta E units, calculated in accordance with ASTM D2244.
(c) Maximum chalk rating: 8, in accordance with ASTM D659.
(d) No checking, crazing, or adhesion loss

4. Bond integrity:
a. Peel strength: Minimum 22.5 in-lb/in, tested to ASTM D1781.
b. Bond strength Minimum 1500 PSI, tested to ASTM C297/297M.
c. No degradation in bond performance after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.

5. Fire hazard characteristics:
a. Flame spread/smoke developed rating: Maximum 25/450, tested to ASTM E84.
b. Surface flammability: Pass modified ASTM E108.
c. V-0 rating: Comply with UL94.

C. Attachment Assembly Components: Formed from extruded aluminum.

D. Attachment Assembly: Manufacturer's standard, Rainscreen principle system.

2.03 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fascia, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain weathertight; and as recommended in writing by metal composite material panel manufacturer.

2.04 FABRICATION

A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
   1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
   2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
   3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
   4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
   5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
   6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
      a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.05 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:
   1. FEVE Fluoropolymer: AAMA 620. Two-coat fluoropolymer with suspended mica flakes or Three-coat fluoropolymer with suspended metallic flakes finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
   1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.
   2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
      a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

3.03 METAL COMPOSITE MATERIAL PANEL INSTALLATION

A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Shim or otherwise plumb substrates receiving metal composite material panels.
   2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
   3. Install screw fasteners in predrilled holes.
   4. Locate and space fastenings in uniform vertical and horizontal alignment.
   5. Install flashing and trim as metal composite material panel work proceeds.
   6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
   7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
   8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:
   1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.

D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
   1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

E. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
   1. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.

F. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-returned flanges of wall panels to panel clips with manufacturer's standard fasteners.
   1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
   2. Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gaskets.

G. Subgirt-and-Spline Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard subgirts and splines that provide support and complete secondary drainage assembly, draining to the exterior at horizontal joints. Attach metal composite material wall panels by interlocking perimeter extrusions attached to panels with subgirts and splines. Fully engage integral subgirt-and-spline gaskets and leave horizontal and vertical joints with open reveal. Terminate edge of panels flush with perimeter extrusions.

1. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
2. Do not apply sealants to joints unless otherwise indicated.

H. Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard horizontal tracks and vertical tracks, drain channels that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach metal composite material wall panels to tracks by interlocking panel edges with manufacturer's standard "T" clips.
1. Attach routed-and-returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
2. Attach flush wall panels to perimeter extrusions by engaging panel edges and by attaching with manufacturer's standard structural silicone adhesive.
3. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
4. Do not apply sealants to joints unless otherwise indicated.

I. Rainscreen-Principle Installation: Install using manufacturer's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal composite material wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
1. Install wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
2. Do not apply sealants to joints unless otherwise indicated.

J. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.

K. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.04 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing agency to perform field tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.

D. Metal composite material wall panels will be considered defective if they do not pass test and inspections.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.06 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.

B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 5200 - MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Modified bituminous roofing membrane, conventional application.

B. Insulation, flat and tapered.

C. Base flashings.

D. Roofing cant strips and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood Blocking and Curbing.

B. Section 07 6200 - Sheet Metal Flashing and Trim: Counterflashings, reglets.

C. Section 07 7100 - Roof Specialties: Counterflashings.

D. Section 07 7200 - Roof Accessories: Prefabricated curb for mechanical equipment.

1.03 REFERENCE STANDARDS

A. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011 (Reapproved 2016).

B. ASTM D312/D312M - Standard Specification for Asphalt Used in Roofing; 2015.

C. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing; 2015a.

D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).

E. FM (AG) - FM Approval Guide; current edition.

F. FS HH-I-526 - Insulation Board, Thermal (Mineral Fiber).

G. FS-HH-I-529 - Insulation Board, Thermal (Mineral Aggregate).

H. FS-HH-I-530 - Insulation Board, Thermal (Urethane).

I. FS-HH-I-551 - Insulation Block and Boards, Thermal (Cellular Glass).

J. FS-LLL-I-535 - Insulation Board, Thermal (Cellulose Fiber).

K. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; Fifth Edition, with interim updates.

L. UL (FRD) - Fire Resistance Directory; current edition.

M. Sheet Metal and Air-Conditioning Contractors National Association, Inc. (SMACNA).

N. CGSB 37GP56M Classification: Type 2, Class C, Grade 1.

1.04 CONTRACTOR'S QUALIFICATIONS

A. Applicator Qualifications: Approved by the manufacturer prior to the bidding period and throughout the installation and able to present a copy of his certification upon request by the Architect or Owner.

1. Applicator must have installed at leave five roofs with similar materials and methods specified for this project that have been warranted for the same number of years as required under this specification by the manufacturer of the product that will be used in the Work.
2. Letter from manufacturer certifying contractor approval to be submitted at time of Bid along with requested warranty specimen.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable codes for roof assembly fire hazard requirements, and:

1. Underwriters Laboratories, Inc. (UL):
   a. Class A Fire Hazard Classification.

2. Meet local IBC Codes for project's location.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of associated flashings and counterflashings installed by other sections.

B. Preinstallation Meeting: Convene one week before starting work of this section.
   1. All parties responsible for work of this section are required to attend including the Architect, Owner, Contractor, Manufacturer and Installer.
   2. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.07 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's catalog data for membrane and bitumen materials, base flashing materials, insulation, and surfacing.

C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, and mechanical fastener layout

D. Manufacturer's Installation Instructions: Indicate special procedures.

E. Manufacturer's Certification that installer is certified by Manufacturer to install roofing system.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

G. Specimen of manufacturer's inspection reports.

1.08 QUALITY ASSURANCE

A. Perform work in accordance with 1 and manufacturer's instructions.

B. Submit certification by the manufacturer of the system materials used that these Specifications and the Drawing Details are acceptable to them for the deck and surfacing to which they are to be applied.
   1. If details for any manufacturer's systems proposed in the Contract Documents are not acceptable to the manufacturer, submit corresponding details proposed for the particular application, together with the manufacturer's reasons for not accepting the conditions depicted in the Specifications or Drawings. No alternate details will be considered without evidence of valid objections on the part of the manufacturer to the Contract requirements.
   2. No deviation is to be made from this Specification without prior written approval by the manufacturer; submit such approval to the Architect.

C. Inspection: Prior to, during installation and at completion of the installation, an inspection shall be made by a representative of the manufacturer in order to ascertain that the roofing system has been installed according to their published specifications, standards and details.
   1. Warranty will be issued upon approval of the installation.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials and store in their unopened original packaging, bearing the manufacturer's name, related standards and any other specification or reference accepted as standard.
   1. When stored outdoors, insulation is to be stacked on pallets or dunnage at least four (4) inches above ground level and covered with "non-sweating" tarpaulins.

B. Protect and permanently store all materials in a dry, well-vented and weatherproof location. Only materials to be used the same day shall be removed from this location. During winter, store materials in a heated location with a 50 degrees F minimum temperature, removed only as needed for immediate use. Keep materials away from open flame or welding sparks.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Carefully store on end materials delivered in rolls with selvage edges up, a minimum of 6-inches above grade. Store metal flashings and counterflashings in such a way as to prevent wrinkling, twisting, scratching and other damage.

E. Avoid stockpiling of materials on roofs without first obtaining acceptance from an Architect/Engineer.

1.10 FIELD CONDITIONS

A. Surfaces on which the roofing membrane system is to be applied shall be clean, smooth, dry, free of fins, sharp edges, loose and foreign materials, oil and grease.
   1. Before beginning work, a representative of the manufacturer shall examine the roof surfaces in order to ensure that the substrate is acceptable.
   2. Do not begin installation until all defective conditions have been corrected.
   3. All surface voids greater than 1/4" wide shall be properly filled with an acceptable fill material.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is below 40 degrees F (5 degrees C).

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

F. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.11 WARRANTY

A. See Section 01 7700 - Closeout Procedures, for additional warranty requirements.

B. Roof System (includes roofing, insulation, related flashings, edge metal, coping metal, and incidental roof system construction components): Manufacturer's 20-year, NO DOLLAR LIMIT, to cover materials and labor to repair any leaks and/or failures occurring within the warranty period. It is the intent that all the roofing accessories be manufactured and/or fabricated in a manner such that the roofing warranty will provide coverage for the roofing accessories.

C. Manufacturer's inspection reports by the manufacturer's technical personnel must be submitted to Architect for final approval of the roof system application.

D. The Contractor is to cover damages to the building resulting from failure to prevent penetration of water during construction.

E. The Contractor is to guarantee all work against defects in materials and workmanship for a period of 2 years following final acceptance of the Work.

F. Correct defective Work within a two year period after Date of Substantial Completion.

G. Provide 20 year manufacturer's material and labor warranty to cover failure to prevent penetration of water.

1.12 LABORATORY TESTING

A. Upon request from the Owner or Architect the elastomeric membrane manufacturers shall supply, at their expense, the results of mechanical and chemical testing performed on the elastomeric cold adhesive materials supplied.

B. The Owner reserves the right to make other independent tests of the in-place roofing. If tests prove satisfactory, all costs shall be borne by the Owner; if tests prove unsatisfactory, all costs for testing activities and remedial work to satisfy contract criteria, and retesting activities shall be borne by the General Contractor.

C. The tests shall be performed to certify compliance with the standards referenced under this section.

1.13 SITE PROTECTION

A. During roofing work, exposed surfaces of finished walls shall be protected with tarps in order to prevent damage. Contractor shall assume full responsibility.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Membrane Materials:
   1. Basis of Design Product: Soprema Roofing and Waterproofing, Inc., www.soprema.com: System #3248, (Torch Applied), Flashing System #3250, (Torch Applied), or comparable system by one of the following:
   2. Siplast, Inc. Paradiene 20 TG/Paradiene 30 TG.
   3. JohnsManville: Dynaply 180/Dynaply 180 GR FR - Torch Applied
   4. Applicators seeking approvals for substitute materials shall submit their request in writing via www.projecttrek.com to the Architect no later than seven (7) working days prior to bid opening.

B. Insulation:
   1. Any insulation made by the selected roof membrane manufacturer, as listed above.
   2. Atlas Roofing Corporation: www.atlasroofing.com.
   3. Hunter panels.
   4. Or prior approved equal.

2.02 MEMBRANE AND SHEET MATERIALS

A. Membrane: Polymer modified asphalt, reinforced with non-woven fabric; granule surfaced; with the following characteristics:

B. Membrane Base Sheet - Soprema Sopra G or Siplast Paravent, or as recommended by roof system manufacturer.
   1. To be installed loose laid over metal deck conditions.

C. Membrane Base Ply: Soprema (#32) - **ELASTOPHENE 180 FLAM**
   Siplast - Paradiene 20 TG
   JohnsManville - Dynaply 180
   1. Description: SBS modified waterproofing membrane shall have a non-woven polyester reinforced and thermofusible plastic film.
   2. Components: Reinforcement shall be 3.68 lbs/sq. non-woven polyester. Elastomeric asphalt shall be a mix of selected bitumen and SBS thermoplastic polymer.
   3. Physical Properties:
      a. Tensile Strength:
         1) Longitudinal - 119 lbs./in.
         2) Transversal - 88 lbs./in.
      b. Ultimate elongation:
         1) Longitudinal - 58%
         2) Transversal - 64%
      c. Static puncture strength - 67 lbs.
      d. Low temperature flexibility, no cracking at -22 degrees F.
      e. SBS elongation - 1500%
      f. Load strain product:
         1) Longitudinal - 6902
         2) Transversal - 5632
      g. Approximate roll weight - 84 lbs (38.1 kgs)
      h. Approximate thickness - 90 mils (2.2 mm)

D. Membrane Top Ply: Soprema (#48) **SOPRALENE FLAM 180 GR FR**
   Siplast - Paradiene 30 TG
   JohnsManville - Dynaply 180 GR FR

1. Description: SBS waterproofing membrane shall have a non-woven polyester reinforcement and thermofusible plastic film. The top side shall be self-protected with colored granules. This membrane is to be torch applied.
   a. Color to be selected by Architect from manufacturer's full range.
2. Components: Reinforcement shall be 3.68 lbs/sq non-woven polyester. Elastomeric cold adhesive shall be a mix of selected bitumen and SBS thermoplastic polymer.
3. Physical Properties:
   a. Tensile strength:
      1) Longitudinal - 119 lbs./in.
      2) Transversal - 88 lbs./in.
   b. Ultimate elongation:
      1) Longitudinal - 58%
      2) Transversal - 64%
   c. Static puncture strength - 67 lbs.
   d. Low temperature flexibility, no cracking at -22 degrees F.
   e. SBS elongation - 1500 %
   f. Load strain product:
      1) Longitudinal - 6902
      2) Transversal - 5632
   g. Approximate roll weight - 105 lbs (47.8 kgs)
   h. Approximate thickness - 160 mils (4 mm)

E. Flashing Membrane Base Ply: Soprema (#32) - **SOPRALENE FLAM 180**

Siplast - System as recommended by manufacturer.

JohnsManville - System as recommended by manufacturer.

1. Description: First membrane flashing ply shall have a non-woven polyester reinforcement and thermofusible elastomeric asphalt. Both sides to have a thermofusible plastic film. This membrane is to be applied by **heat welding only**.
2. Components: Reinforcement shall be 3.68 lbs/sq. non-woven polyester. Elastomeric asphalt shall be a mix of selected bitumen and SBS thermoplastic polymer.

F. Flashing Membrane Cap Ply: Soprema (#50) - **SOPRALAST 50 TV ALU**

Siplast - Veral Aluminum.

JohnsManville - System as recommended by manufacturer.

1. Description: Cap membrane flashing ply shall have a fiberglass scrim/fiberglass mat composite impregnated and coated with high quality styrene-butadiene-styrene (SBS) modified bitumen and surfaced with a protective aluminum foil facing. This membrane is to be applied by heat welding only.

2.03 FASTENERS

A. Base layer of insulation: Mechanical fasteners for securement of insulation to decking shall be approved by manufacturer. Manufacturer to provide fastening pattern and type of fastener to be used.

2.04 WOOD BLOCKING

A. All nailers and blocking material to be free of wane, shake, decay or checks, and pressure-treated with water-borne preservatives for above ground use, AWPB LP-2.
   1. Blocking shall be not less than Construction Grade, Southern Pine.

2.05 ROOF INSULATION

A. Rigid insulation base layer thickness shall be as indicated on roof plan, Polyisocyanurate-Foam Board Insulation, at locations as indicated on drawings, to achieve an average R value of R-30 for base layer. Insulation may be applied in one layer using 4' x 4' or 4' x 8' boards. This insulation must have a minimum compressive strength of 25 psi.
   1. Polyisocyanurate (use only Atlas ACII, or Hunter "H" Shield for warranty).
   2. Min. 4" thick base layer of Rigid Insulation unless indicated otherwise in Drawings.

B. At metal and concrete deck, mechanically fasten the first layer of insulation and subsequent tapered insulating system at crickets and 1/2" cover board over deck.

C. Tapered Insulation (see above for approved polyiso manufacturers for warranty).
   1. The tapered insulation system shall have a minimum thickness of 1/2" and an average LTTR, (Long Term Thermal Resistance) value of 4.5 1/2 inch to 1 inch, Mark AA.
   2. The roof shall have a slope of not less than 1/4":12 and a minimum thickness as indicated on drawings.
   3. The tapered boards shall be factory formed units of the specified insulation board.

D. Cover Board shall be 1/2" thick, type as recommended by roof manufacturer.
   1. Cover board shall be installed over insulation with long joints in continuous straight lines with end joints staggered a minimum of 12" away from joints of insulation.

E. Crickets
   1. Crickets shall be installed where shown on the drawings, sloping to valleys to prevent water accumulation.
   2. Crickets shall be constructed from factory formed units of the specified insulation board.

F. Drain Sumps
   1. 1/2":12" tapered insulation board for installation of drain sumps.

2.06 PRIMER

A. Asphalt Primer - Soprema - **ELASTOCOOL 500**
   Siplast - PA-1125 Asphalt Primer
   JohnsManville - JM Asphalt Primer
   1. Primer shall be applied on all dissimilar materials except insulation.
   2. Description: Black bituminous varnish.
   3. Composition: Asphalt modified bitumen with thermoplastic polymers and volatile solvents.

2.07 WALKWAYS

A. Walkway Pads: Reinforced asphaltic composition pads with slip-resisting mineral-granule surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 1/2 inch thick, minumum.
   1. Pad Size: 2 ft x 2 ft minimum.

B. Walkway Cap Sheet Strips: ASTM D 6163 or ASTM D 6164, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers or reinforced with polyester fabric); granular surfaced; suitable for application method specified, and as follows:
   1. Granule Color: To match color of roofing system granules.

2.08 MISCELLANEOUS

A. Expansion Joint System: SOPRAJOINT, Expandoflash, or equal as produced by the membrane manufacturer.

B. Water Cut-Off Mastic: Sopracolle 300, SBS Elastic cement, Sopramastic 200, MBR Cold Application Adhesive, or equal as approved by the membrane manufacturer.

C. Gusset Material: Sopralene 180 Flam, Sopralene Flam Stick, DynaWeld 180 S or equal as approved by the membrane manufacturer..

PART 3 EXECUTION

3.01 SURFACE INSPECTION AND PREPARATION

A. Before commencing work, all surfaces shall be smooth, clean, dry and free of any debris that would adversely effect the installation of the membrane.
   1. See 1.10 of this Section - Field Conditions.

B. Before commencing work, the manufacturer's technical representative, together with the roofing contractor, shall inspect and approve the deck condition (slopes and nailing supports if applicable) as well as verticals on parapet walls, roof drains, stack vents, vent outlets and others, building joints, etc. If applicable, a non-compliance notice shall be submitted to the

Contractor so that adjustments can be made. Commencement of work shall imply acceptance of surfaces and conditions.

C. Verify that the work of other trades has been properly completed.

D. Do not install materials in conditions of inclement weather.

3.02 SURFACE PREPARATION

A. (Metal Deck): Verify slope and condition of metal decking.

B. (Concrete Deck): Verify slope and condition of concrete decking.

C. Clean substrate of dust, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

D. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 INSTALLATION

A. Install roofing membrane on clean and dry surfaces, in accordance with the manufacturer's requirements and recommendations.

B. Perform roofing work on a continuous basis as surface and weather conditions allow.

C. Protect adjoining surfaces against any damage that could result from roofing installation.

D. Install only as much roofing as can be completed in one day. If weather conditions do not permit such completion, exposed areas shall be temporarily weatherproofed to prevent any water or snow infiltration from damaging other materials already installed, in particular, the thermal insulation.

3.04 EQUIPMENT

A. Maintain all equipment and tools in good working order.

3.05 INSTALLATION OF INSULATION

A. Comply with roofing system manufacturer's written instructions for installing roof insulation.

B. At metal deck: Attach insulation with mechanical fasteners per manufacturer's requirements to meet the required uplift and fire ratings. The insulation board surface shall provide a smooth surface to accept cover board.

C. At concrete deck: Attach base insulation layer with mechanical fasteners per manufacturer's requirements to meet the required uplift and fire ratings. The insulation board surface shall provide a smooth surface to accept Securock cover board.

D. Apply only as much insulation and cover board to the roof as can be covered the same day with roofing membrane. At the conclusion of each day's work, seal exposed edges of the insulation. Cut and remove seal upon continuation of the work.

E. No insulation piece shall be less than twelve by twelve inches (12" x 12").

3.06 FIELD BASE PLY INSTALLATION

A. Unroll dry base ply membrane on insulation for alignment. Each strip shall have three (3) inch side laps and six (6) inch end laps.
   1. Begin at low point of roof.
   2. Place membrane so side lap is centered on drain line.

B. Reroll base ply (halfway) one end at a time in accordance with recommendation of roof manufacturer, onto approved substrate.

C. Roll the membrane into a full width application of cold adhesive. The membrane must be firmly and uniformly set, without voids, into the cold adhesive.

D. Application shall provide a smooth surface, free of air pockets, wrinkles, fishmouths or tears.

E. Using a weighted roller seal the membrane for proper adhesion.

F. Seal all laps by running a hot trowel along the edge of the seam.

G. Run membrane tight up against all vertical surfaces such as curbs, parapets, and vents.

3.07 BASE PLY FLASHING INSTALLATION

A. Prior to application, the vertical surface receiving the base ply flashing shall receive a coat of primer at the rate of 150-200 sq. ft/gallon. This primer coating must be tacky before application of the base sheet flashing.

B. Lay base ply flashing in strips three (3) feet wide to the vertical surfaces, extending onto the flat surface of the roof a minimum of four (4) inches. Side laps shall be three (3) inches and shall be staggered a minimum of four (4) inches with the laps of the base ply.
   1. ELIMINATE ALL VOIDS IN CORNERS AND AT LAPS.

3.08 FIELD TOP PLY INSTALLATION

A. Once the base ply is applied and does not show any defects, install the FIELD cap ply.

B. Unroll top ply starting from the low point of the roof. Care must be taken to insure good alignment of the first roll (parallel with the edge of the roof). A 45 degree angle cut shall be made on the selvage edge of underlying membrane prior to application. This is to insure a good seal at the membrane end laps and help eliminate "t" laps.

C. Stagger base ply and top ply side seams a minimum of twelve (12) inches from one another. End laps should be staggered three (3) feet.

D. Top ply shall have side laps of three (3) inches and end laps of six (6) inches.

E. Roll the membrane into a full width application of cold adhesive. The membrane must be firmly and uniformly set, without voids, into the cold adhesive.

F. Using a weighted roller, seal the membrane for proper adhesion.

G. Application shall provide a smooth surface, free of air pockets, wrinkles, fishmouths or tears.

H. Seal all laps by running a four (4) inch wide weighted roller over laps of the side seam.

I. Run membrane tight up against any vertical surfaces such as curbs, parapets, and vents.

J. After installation of the top ply, check all lap seams on the top ply using the edge of a hot trowel. Correct all defects.

K. During installation, avoid cold adhesive seepage greater than 1/4 inch at seams.
   1. Cover cold adhesive seepage with a sprinkling of loose granules, color to match membrane. Apply granules at time of installation.

3.09 FLASHING TOP PLY INSTALLATION

A. Lay top ply flashing in strips three (3) feet wide.
   1. Side laps shall be three (3) inches and shall be staggered a minimum of four (4) inches from top ply laps in order to avoid excessive thickness.

B. Using a chalk line, lay-out a straight line on the surface of the top ply, parallel to the roof edge, six (6) inches inside the roof edge, or from the base of the cant strip or right angle to be flashed.
   1. Using a torch and heated flat trowel, embed the surface granules into the heated and soft bitumen from the chalk line to the edge of the top ply, and to the top of the cant or right angle.

C. Heat weld top ply in accordance with recommendations of roofing manufacturer, onto the field base membrane ply a minimum of six (6) inches.
   1. During this application, simultaneously melt both surfaces forming an asphalt bead that pushes out in front of the top sheet.

D. Do not burn the membrane and their respective reinforcements.

E. Stagger base ply and top ply seams a minimum of twelve (12) inches.

F. Ensure the two membranes are perfectly welded, without air pockets, wrinkles, fishmouths or tears.

G. After installation of the top ply, check all lap seams on the top ply using the edge of a hot trowel. Correct any defect.

H. During installation, avoid asphalt seepage greater than 1/4 inch at seams.

3.10 WATER CUT-OFF

A. At the end of the day's work, and when precipitation is eminent, a water cut-off shall be constructed at all open edges. Construct the cut-off with the same membrane and cold adhesive. Cut-off must be able to withstand extended periods of wet weather. The water cut-off shall be completely removed prior to resuming the installation of the roofing system.

3.11 CLEANING

A. Clean-up and remove daily from the site all wrappings, empty containers, paper, loose particles and other debris resulting from these operations.

B. Remove cold adhesive markings from finished surfaces.

C. Repair or replace defaced or disfigured finishes caused by work of this section.

3.12 PROTECTION

A. Provide traffic ways, erect barriers, fences, guards, rails, enclosures, chutes and the like to protect personnel, roofs and structures, vehicles and utilities.

B. Plywood boards for traffic ways are required for any traffic movement over existing roofs. Plywood shall be not less than 5/8-inch thick.

C. In addition to the plywood listed above, an underlayment of minimum 1/2-inch recover board is required on new roofing.
   1. Special permission must be obtained from the manufacturer before any traffic will be permitted over new roofing.

3.13 FIELD CONTROL

A. Field inspection will performed as outlined under 1.08 "Quality Assurance", of this section.

3.14 PITCH BOXES

A. Install metal pitch box as per details assuring minimum 2-inch clearance around penetrations.
   1. Provide minimum 6-inch height above finished roofing.
   2. Set primed flanges onto base ply assuring box rim is level and true.

B. Seal by applying a reinforcing strip of base ply material that extends beyond the flange a minimum of 6-inches onto the roof.
   1. Seal all edges and seams.

C. Top ply installed as specified in 3.08 of this Section.

D. Fill box with lightweight grout filler to a minimum of 2-inches below the top edge of metal box. Seal boxes full to top with (1 or 2 part) pourable urethane sealer.
   1. Provide a sloped surface on sealer to the outside edge of the box on all sides.
   2. Optional - Provide a metal storm collar on all boxes.

3.15 ROOF DRAINS

A. Provide a smooth transition from drain bowl to deck surface.
   1. Taper insulation back from drain a minimum of 24-inches to provide for positive drainage.
   2. Prime all surfaces of metal (drain base, leads and/or copper if used).
   3. Using a trowel, set a 6-inch wide layer of mastic around the drain bowl edge as water cut-off and seal on top of the drain base.

B. Install base ply membrane with lap centered on drain bowl and as specified under 3.06 of this section ensuring a tight seal at drain base.
   1. Apply a reinforcing sheet of base ply membrane three feet square centered over drain.
   2. Carry all plies of membrane inside the edge of the drain bowl and temporarily secure all plies with the clamping ring. Cut a hole in membranes slightly larger in diameter than the down-pipe opening (should leave about 1" of membrane inside the clamping ring).

C. Install top ply as specified in 3.08 of this section.
   1. Cut membrane opening 1" inside the edge of the drain bowl. Hole must be slightly larger than the down-pipe opening.
   2. Position membrane so as to be centered on the drain base and avoid the occurance of any seams into drains. All other adjacent plies will shed 6" (min.) onto this ply.
   3. Seat drain clamping ring by heating it and firmly pressing it into place.

D. Install clamping ring and drain covers supplied with drain.

E. Test all drains for proper flow and watertightness. Correct defects.

3.16 VENT (STACK)

A. Inspect base ply installation and ensure tight seal around pipe.

B. Construct and install sheet metal vent sleeve as per details over base ply.
   1. Provide a minimum 5-inch base flange.
   2. Prime all metal surfaces.

C. Apply a reinforcing sheet of base ply material three feet square over the vent.
   1. Seat all seams and edges with a trowel.

D. Install top ply as specified in 3.08 of this section.
   1. Cut membrane to fit tight against stack sleeve and seal by running a heated trowel around vent base.

E. Install metal vent cap.

3.17 EXPANSION JOINT

A. Ensure all surfaces are soundly secured and fully primed prior to the installation of any membrane or flashing.

B. Install base ply as specified in 3.06 of this section.
   1. Stop base ply membrane at juncture of horizontal to vertical surface.

C. Install base flashing as detailed and in accordance with 3.07 of this section.
   1. Flashing must extend a minimum of 4-inches onto the base ply and continue up the vertical surface onto the top edge of the expansion joint support and secure using roofing nails.
   2. Fill the expansion joint with compressible insulation supported by a layer of polyethylene film nailed off at top.

D. Provide a continuous joint cover of mineral cushion as detailed.
   1. Width of cushion to be three times that of the joint.

E. Install pre-fabricated expansion joint cover by installing flanges onto expansion support and ensuing a minimum of 4-inch surface contact.

F. Install top ply flashing as per 3.09 of this section.
   1. Run flashing top of vertical surface of support and onto roof surface a minimum of 6-inches.
   2. Set all granules into membrane using a hot trowel where flashing overlap occurs.
   3. Install a slip sheet over joint as separation between joint cover and top ply.

G. Cover the entire expansion joint with a single layer of top ply flashing as detailed and following specifications outlined in 3.09 of this section.

3.18 CORNER FLASHING

A. Inside Corners:
   1. Prime areas to receive flashings. Pre-cut all flashing pieces to fit areas to be flashed.
   2. Fabricate gussets 4-inch wide by 8-inch long with 2-inch triangular tips each end.
      a. Install gussets into each corner using an electric heat gun and heated trowel.
      b. Set preheated gussets tightly into corners with triangular tips folded inward. Using a heated trowel adhere gussets a minimum 2-inches on each side and fold tips by

melting them with the heated trowel. (Self adhesive gussets are available as an alternate - check with your technical assistant).

3. Pre-cut base flashing membranes to provide a 4-inch tie-in to roof surface and 3-inch return at corner.
4. Apply first piece of base flashing membrane into corner to cover gusset. Pressing overlap and tie-in firmly into position with a trowel.
5. Apply adjacent piece of base flashing sheet into position with edge tight into corner.
   a. Base tie-ins on selvage must be cut at 45-degrees to eliminate voids at T-laps.
   b. Seal all edges with a heated trowel.
6. Pre-cut top flashing membranes to provide a 6-inch tie-in to roof surface and 3-inch return at corner.

B. Outside Corners:
1. Pre-cut all flashing pieces and prime all surfaces prior to installation.
2. Fabricate gusset 4-inch wide by 8-inch long with a 2-inch triangular tip.
   a. Install gusset into corner using electric heat gun and firmly pressing with a trowel.
   b. Set gusset with triangular tip on base ply and wrapping the corner a minimum of 2-inches on each side.
3. Pre-cut base flashing membranes to provide a 4-inch tie-in to roof surface and 3-inch return at corner.
4. Apply first base flashing sheet into corner over gusset pressing overlap and tie-in firmly into position with a hot trowel.
5. Apply second base flashing sheet into position with returns wrapped around corners.
   a. Cut off base tie-in selvage at 45-degree from vertical.
   b. Seal all edges with a trowel.
6. Pre-cut top flashing membranes to provide a 6-inch tie-in to roof surface and 3-inch return at corner.

3.19 CURBS

A. Inspect and verify that all curbs are properly secured to deck, are level, a minimum of 6-inches above finished roof, primed and ready to receive flashings.

B. Base ply membrane is to run horizontally tight up against the vertical curb or cant as required.
1. When base ply membrane is to act as temporary seal for an extended length of time, carry membrane up vertical surface a minimum of 1-inch.

C. Gusset to be fabricated 4-inch wide by 8-inch long with a 2-inch triangular tip.
1. Install gusset onto corner using electric heat gun and firmly pressing with a hot trowel.
2. Set gusset with triangular tip on base ply and wrapping the corner a minimum of 2-inches on each side.

D. Install base ply flashing according to 3.07 of this section.
1. Pre-cut flashing to the total sum of curb height, thickness plus 1-inch for inside curb securement and 4-inch tie-in along base with width to match that of curb plus 3-inch overlap on each end.
2. Secure along inside of curb with roofing nails.
3. Cut back corner base selvage at 45-degree angle from vertical.

E. Install top ply as specified under 3.08 and 3.09 of this section.
1. Pre-cut flashing to the total sum of curb height plus 6-inches for base tie-in with width to match that of curb plus 3-inch overlap at each end.
2. Set granules with heated trowel on all surfaces to receive flashing.
3. Cut flashing flush with the top of curb and seal edges with heated trowel.
4. Cut back corner base selvage at 45-degree angle from vertical.
5. Firmly press flashing into position using a damp sponge.

F. Provide metal counter flashing.

3.20 ROOF EDGE

A. Install base ply membrane as specified in 3.06 of this section. Carry membrane over roof edge (a minimum of 3-inches) and temporarily fasten to bottom most nailer using galvanized roofing nails.

B. Install a continuous metal cleat (material) and metal edge as detailed.
   1. Prime all dissimilar surfaces prior to membrane or flashing installation.
   2. Minimum metal edge flange to be 4-inch and set into beads of mastic cement.
   3. Nail metal flange through base ply membrane to decking or wood blocking at 4-inch on center - staggered.

C. Cover edge with a reinforcing strip of base membrane cold applied into place. Membrane is to carry beyond the metal flange onto base ply a minimum of 4-inches.
   1. Hold the reinforcing strip back from outside of metal edge by 3/4-inch.
   2. Seal all membrane edges with a heated trowel or electric heat gun.

D. Install top ply of membrane according to 3.08 of this section with the edge tight against the metal and sealed with a hot trowel.

3.21 COPING/PARAPETS

A. Verify all surfaces are properly secured and fully primed, ready to receive flashings.

B. Base ply membrane is to run horizontally tight up to the vertical or cant as required.

C. Install base ply flashing according to 3.07 of this section. Carry flashing up the vertical surface, over the top and down the outside face of the parapet a minimum of 3-inches. Fasten along outside edge at 4-inch centers using roofing nails.
   1. Install continuous metal cleats as detailed.
      a. Prime all dissimilar surfaces prior to membrane or flashing installation.
      b. Flashing on edge to be 4-inch minimum and set into full width of mastic.
      c. Nail flanges to wood blocking at 4-inches on center - staggered.
   2. Apply top membrane and flashing as detailed and specified under 3.08 and 3.09 of this section.

3.22 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field quality control and inspection.

B. Require site attendance of roofing and insulation material manufacturers daily during installation of the Work.

3.23 CLEANING

A. Remove bituminous markings from finished surfaces.

B. In areas where finished surfaces are soiled by bitumen or other source of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.24 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and sill pans at storefront system, flashing at storefront system, trim on fascia and vertical wall above roof, scuppers, and other items indicated.

B. Sealants for joints within sheet metal fabrications.

C. Reglets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood nailers for sheet metal work.

B. Section 07 7100 - Roof Specialties: Manufactured copings, flashings, and expansion joint covers.

C. Section 07 7200 Roof Accessories: Manufactured metal roof curbs.

D. Section 07 9200 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.03 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

C. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

F. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products; 2014.

G. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

H. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).

I. CDA A4050 - Copper in Architecture - Handbook; current edition.

J. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

C. Samples: Submit two samples 2 by 4 inch (____by____ mm) in size illustrating metal finish color.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Maintain one copy of each document on site.

C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with ____ years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) (0.81 mm) thick; plain finish shop pre-coated with modified silicone coating.
   1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As selected by Architect from manufacturer's full colors.
      a. Provide custom color to match adjacent ACM metal panels where formed brake metal fascia and soffit are designated.

B. Lead Sheet: ASTM B749, 0.047 inch (1.19 mm) minimum thickness; UNS Number L51121.

C. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gage, (0.0156 inch) (0.40 mm) thick; smooth No. 4 - Brushed finish.

2.02 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Underlayment: Polyethylene, 6 mils (0.15 mm) thick.

C. Primer: Zinc chromate type.

D. Protective Backing Paint: Zinc molybdate alkyd.

E. Sealant to be Concealed in Completed Work: Non-curing butyl sealant.

F. Sealant to be Exposed in Completed Work: 1; elastomeric sealant, 100 percent silicone with minimum movement capability of plus/minus 25 percent and recommended by manufacturer for substrates to be sealed; clear.

G. Plastic Cement: 1, Type I.

H. Reglets: Surface mounted type, galvanized steel .

I. Solder: 1; Sn50 (50/50) type.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.

G. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.04 SUPPER AND DOWNSPOUT FABRICATION

A. Downspouts, Gutters: SMACNA Architectural Sheet Metal Manual, Rectangular profile, unless otherwise indicated in Drawings.

B. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).

C. Accessories: Profiled to suit downspouts.
   1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
   2. Gutter Supports: Brackets.
   3. Downspout Supports: Brackets.

D. Splash Block Diffusers: Located at all locations where a downspout outfalls onto a roof.

E. Downspout Boots: Cast Aluminum, as specified in Section 05 5000.

F. Seal metal joints.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

3.03 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

D. Solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.

E. Secure downspouts in place with concealed fasteners.

F. Slope gutters 1/4 inch per 10 feet (2.1 mm per m), minimum.

G. Connect downspouts to downspout boots, and grout connection watertight.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 07 7100 - ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured roof specialties, including copings, fascias, and gravel stops.

B. Roof control and expansion joint covers.

1.02 RELATED REQUIREMENTS

A. Section 07 5200 Modified Bitumen Membrane Roofing - Alternate No. 5

B. Section 07 7200 - Roof Accessories: Manufactured curbs.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.

B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2017.

C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.

D. NRCA (RM) - The NRCA Roofing Manual; 2017.

E. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; 2011.

1.04 SUBMITTALS

A. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

B. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.

C. Samples: Submit two appropriately sized samples of coping and gravel stop.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Roof Edge Flashings and Copings:
   1. Architectural Products Co: www.archprod.com.
   2. W.P. Hickman Company; PermaSnap 2 Coping: www.wph.com.

B. Control and Expansion Joint Covers:
   1. Construction Specialties, Inc; Roof Covers: www.c-sgroup.com/#sle.
   2. EMSEAL Joint Systems, Ltd; Emseal RoofJoint: www.emseal.com/#sle.
   3. _____.

2.02 COMPONENTS

A. Roof Edge Flashings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
   1. Configuration: Fascia, cant, and edge securement for roof membrane.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.

B. Copings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
   1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness and finish as cap; concealed stainless steel fasteners.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
   3. Material: Formed aluminum sheet, 0.050 inch (1.3 mm) thick, minimum.

4. Finish: 70 percent polyvinylidene fluoride.
5. Color: To be selected by Architect from manufacturer's full range.
6. Manufacturers:
    a. W.P. Hickman Company; PermaSnap 2 Coping: www.wph.com.

C. Control and Expansion Joint Covers: Composite construction of 8 inch (____ mm) wide flexible EPDM flashing of white color with closed cell urethane foam backing, each edge seamed to aluminum sheet metal flanges, designed for nominal joint width of 1 inch (25.4 mm). Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.

2.03 FINISHES

A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

B. Seal joints within components when required by component manufacturer.

C. Coordinate installation of components of this section with installation of roofing membrane and base flashings.

D. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

END OF SECTION

SECTION 07 7200 - ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured curbs.

1.02 RELATED REQUIREMENTS

A. Section 05 3100 - Steel Decking.

B. Section 07 52 00 - Modified Bituminious Membrane Roofing

C. Section 07 6200 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

D. Section 07 7100 - Roof Specialties: Other manufactured roof items.

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

B. FM (AG) - FM Approval Guide; current edition.

1.04 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.

D. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ROOF CURBS

A. Manufacturers:
   1. AES Industries Inc.: www.aescurb.com.
   2. The Pate Company: www.patecurbs.com.
   3. Roof Products & Systems (RPS); _____: www.rpscurbs.com/#sle.

B. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
   1. Roof Curb Mounting Substrate: Curb substrate consists of standing seam metal roof panel system.
   2. Sheet Metal Material:

a. Aluminum: 0.080 inch (2.03 mm) minimum thickness, with 3003 alloy, and H14 temper.

3. Fabricate curb bottom and mounting flanges for installation directly on metal roof panel system to match slope and configuration of system.
   a. Extend side flange to next adjacent roof panel seam and comply with seam configurations and seal connection, providing at least 6 inch (152 mm) clearance between curb and metal roof panel flange allowing water to properly flow past curb.
   b. Where side of curb aligns with metal roof panel flange, attach fasteners on upper slope of flange to curb connection allowing water to flow past below fasteners, and seal connection.
   c. Maintain at least 12 inch (305 mm) clearance from curb, and lap upper curb flange on underside of down sloping metal roof panel, and seal connection.
   d. Lap lower curb flange overtop of down sloping metal roof panel and seal connection.
4. Provide layouts and configurations indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.
   1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
   2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
   3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
   4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of uncoated aluminum and stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
   3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.04 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 9000 "Painting and Coating."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 8400 - FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2013a.

B. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2015a.

C. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013.

D. ITS (DIR) - Directory of Listed Products; current edition.

E. FM (AG) - FM Approval Guide; current edition.

F. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

G. UL (FRD) - Fire Resistance Directory; current edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures, for submittal process.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

C. Product Data: Provide data on product characteristics, performance ratings, and limitations.

D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Installer Qualification: Submit qualification statements for installing mechanics.

1.04 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
   3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.05 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

1.06 PROJECT COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturers:
   1. A/D Fire Protection Systems Inc.: www.adfire.com.
   2. 3M Fire Protection Products: www.3m.com/firestop.
   3. Hilti, Inc: www.us.hilti.com/#sle.
   4. Specified Technologies, Inc.: www.stifirestop.com.
   5. Tremco, Inc.; Tremco Fire Protection Systems Group..

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.02 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Fire-resistance-rated walls include fire-barrier walls smoke-barrier walls and fire partitions.
   2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-wool-fiber or rock-wool-fiber insulation.
      b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      c. Fire-rated form board.
      d. Fillers for sealants.
   2. Temporary forming materials.
   3. Substrate primers.
   4. Collars.
   5. Steel sleeves.

E. Basis of Design Products:
   1. Hilti Firestop Systems Flexible Firestop Sealant CP 606 - Acrylic based firestop sealant that provides movement in fire rated joint applications.
   2. Hilti Firestop Systems Firestop Collar CP 643 - ready to use firestop collar made of galvanized steel housing and intumescent inserts for firestopping combustible pipes.
   3. Hilti Firestop Systems Firestop Wrap Strip CP 645 - Intumescent flexible firestop wrap strip for plastic and insulated pipe penetrations.
   4. Hilti Firestop Systems Firestop Putty Pad CP 617 and CP 517L - Intumescent modlable firestop putty designed to help protect electrical outlet boxes.

5. Hilti Firestop Systems High Performance Intumescent Firestop Sealant FS-ONE - Intumescent firestop sealant that helps protect combustible and non-combustible penetrations for up to 4 hours fire rating.
6. Owens Corning Thermafiber Safing Fire Containment Insulation - Non-combustible, moisture resistant, noncorrosive, nondeteriorating, mildew proof and vermin proof

F. Basis of Design UL Systems:
1. Metal Pipe through Concrete Floor/Wall or Block Wall: Hilti Firestop Systems - UL System No. C-AJ-1149.
2. Plastic Pipe through Concrete Floor/Wall or Block Wall: Hilti Firestop Systems - UL System No. C-AJ-2217.
3. Plastic Pipe through Concrete Floor/Wall or Block Wall: Hilti Firestop Systems - UL System No. C-AJ-2337.
4. Cable Bundle Through Concrete Floor/Wall or Block Wall: Hilti Firestop Systems - UL System No. C-AJ-3181
5. Insulated Metal Pipe Through Concrete Floor/Wall or Block Wall: Hilti Firestop Systems - UL System No. C-AJ-5301
6. Plastic Pipe Through Concrete Floor/Wall or Block Wall: Hilti Firestop Systems - UL System No. C-AJ-2342
7. Plastic Pipe Through Concrete/Wall or Block Wall: Hilti Firestop Systems - UL System No. C-AJ-2372
8. Plastic Pipe Through Concrete/Wall or Block Wall: Hilti Firestop Systems - UL System No. C-AJ-2567
9. Plastic Pipe Through Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-2344
10. Plastic Pipe Through Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-2244
11. Plastic Pipe Through Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-2335
12. Plastic Pipe Through Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-2406
13. Multiple PEX Tubing Through Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-2480
14. Plastic Pipe Through Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-2473
15. Cable Bundle Through Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-3320
16. Cable Bundle Through Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-3065
17. Metal Pipe Through 1 hr or 2 hr Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-1297
18. Multiple Metallic Pipes Through Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-1408
19. Insulated Metal Pipe Through Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-5257
20. Metal Duct (Without Damper) Through 1 hr or 2 hr Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-7040
21. Insulated Duct (Without Damper) Through 1 hr or 2 hr Gypsum Wall Assembly: Hilti Firestop Systems - UL System No. W-L-7059

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
1. Basis of Design: Hilti Firestop Systems - System No. CEJ-265-P
2. Movement: Provide systems that have been tested to show movement capability as indicated.

3. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
4. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
5. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.

B. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
1. Movement: Provide systems that have been tested to show movement capability as indicated.

2.04 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.05 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

2.06 MATERIALS

A. Provide materials approved by authority having jurisdiction and meeting UL requirements for hourly rating of assembly being penetrated.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.03 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

3.05 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.06 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.07 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 9200 - JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior joints in vertical surfaces and non-traffic horizontal surfaces as indicated below:
   1. Control and expansion joints in unit masonry.
   2. Joints between different materials.
   3. Perimeter joints between materials listed above and frames of doors and windows.
   4. Control and expansion joints in ceiling and overhead surfaces.
   5. Other joints as indicated.

B. Exterior joints in horizontal traffic surfaces as indicated below:
   1. Control, expansion, and isolation joints in cast-in-place concrete slabs.

C. Interior joints in vertical surfaces and horizontal non-traffic surfaces as indicated below:
   1. Control and expansion joints on exposed interior surfaces of exterior walls.
   2. Perimeter joints of exterior openings where indicated.
   3. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
   4. Perimeter joints of toilet fixtures.
   5. Other joints as indicated.

D. Owner-provided field quality control.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping: Firestopping sealants.

1.03 REFERENCE STANDARDS

A. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

B. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2013.

1.04 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.05 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.

C. Samples: For each type of color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Preconstruction field test reports.

E. Compatibility and adhesion test reports.

F. Product certificates:
   1. Certification by joint sealant manufacturer that sealants plus the primers and cleaners required for sealant installation comply with local regulations controlling use of volatile organic compounds.

G. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

H. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

I. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

J. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant application similar in material, design and extent to that indicated for Project that have resulted in construction with a record of five (5) years successful in-service performance.

B. Single Source Repsonsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

C. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 that is appropriate for the types of Project joints.

E. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
   1. Identification of testing agency.
   2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
      a. Test date.
      b. Copy of test method documents.
      c. Age of sealant upon date of testing.
      d. Test results, modeled after the sample form in the test method document.
      e. Indicate use of photographic record of test.

F. Owner will employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.

G. Field Quality Control Plan:
   1. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

H. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
   4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
   5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.

6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

I. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
   1. Sample: At least 18 inches (457 mm) long.
   2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch (25.4 mm) by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
   3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.

J. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Five (5) years from date of Substantial Completion.

C. Speical Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.02 MATERIALS - GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by manufacturer's full range.

2.03 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied, chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure adn joint substrates.
   1. Additional Movement Capability: Where additional movement capability is specified in Elastomeric Joint Sealant Data Sheet, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrated indicated for Project.

C. Suitability for Immersion in Liquids: Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Type **ES-1**: Single-Component Neutral-Curing Silicone Sealant.
   1. Products:
      a. Dow Corning Corporation; 795.
      b. GE Silicones; UltraGlaze Silpruf.
      c. Bostick Construction; Chem-Calk 1000
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25
   4. Uses Related to Exposure: NT (non-traffic).
   5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

F. Type **ES-2**: Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant.
   1. Products:
      a. Pecora Corporation: 898.
      b. Tremco: Tremsil 600 White.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25
   4. Uses Related to Exposure: NT (non-traffic).
   5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

G. Type **ES-3**: Multi-Component Nonsag Urethane Sealant.
   1. Available Products:
      a. Sonneborn, Division of BASF Construction Chemicals, LLC.; Sonolastic SL-2.
      b. Pecora Corporation; Urexpan NR-200.
   2. Type and Grade: M (multi-component) and SL (self-leveling).
   3. Class: 25
   4. Uses Related to Exposure: T (traffic).
   5. Uses Related to Joint Substrates: M, G, A and, as applicable to joint substrates indicated, O.

2.04 LATEX JOINT SEALANTS

A. Type **LS-1**: Latext Sealant: Comply with ASTM C 834, Type P, Grade NF.
   1. Available Products:
      a. Bostik Findley; Chem-Calk 600.
      b. Pecora Corporation; AC-20+.
      c. Schnee-Morehead, Inc.; SM 8200.
      d. Sonneborne, Division of BASF Construction Chemicals, LLC.; Sonolac.
      e. Tremco; Tremflex 834.

2.05 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

D. Bond-Breaker Type: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.06 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

2.07 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
   1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
   2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
   3. Record each test on Preinstallation Adhesion Test Log.
   4. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.

5. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
      a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
   2. Remove laitance and form-release agents from concrete.
      a. Clean non-porous surfaces with chemical cleaners or other means that do not stain, harm, substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant applications and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact adn fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allows optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application adn before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint configurations per Figure 5A in ASTM C 1193, unless otherwise indicated.

G. Installation of Preformed Silicone-Sealant System: Comply with manufacturer's written instructions.

H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

I. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

J. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

K. Perform installation in accordance with ASTM C1193.

L. Measure joint dimensions and size joint backers to achieve the following:
1. Width/depth ratio of 2:1.
2. Neck dimension no greater than 1/3 of the joint width.
3. Surface bond area on each side not less than 75 percent of joint width.

M. Install bond breaker backing tape where backer rod cannot be used.

N. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

O. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

P. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

Q. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 JOINT SEALANT SCHEDULE

A. Joint-Sealant Application **JS-1**: Exterior horizontal traffic isolation and contraction joints in cast-in-place concrete slabs.
1. Joint Sealant: Multi-component pourable urethane sealant **ES-3**.
2. Joint Sealant Color: Selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application **JS-2**: Exterior vertical control and expansion joints in unit masonry.
1. Joint Sealant: Single-component neutral-curing silicone sealant **ES-1**.
2. Joint Sealant Color: Selected by Architect from manufacturer's full range of colors.

C. Joint Sealant Application **JS-3**: Exterior perimeter joints between metal wall panels and frames of doors, windows and louvers.
1. Joint Sealant: Single-component neutral-curing silicone sealant **ES-1**.

D. Joint Sealant Application **JS-4**: Exterior control and expasion joints in building.
1. Joint Sealant: Single-component neutral-curing silicone sealant **ES-1**.
2. Joint Sealant Color: Selected by Architect from manufacturer's full range of colors.

E. Joint Sealant Application **JS-5**: Exterior joints in vertical and horizontal non-traffic surfaces at building.
1. Joint Sealant: Single-component neutral-curing silicone sealant **ES-1**.
2. Joint Sealant Color: Selected by Architect from manufacturer's full range of colors.

F. Joint Sealant Application **JS-1**: Vertical control and expansion joints on exposed interior surfaces of exterior walls.
1. Joint Sealant: Single-component neutral-curing silicone sealant **ES-1**.

2. Joint Sealant Color: Selected by Architect from manufacturer's full range of colors.

G. Joint Sealant Application **JS-2**: Interior perimeter joint of exterior openings.
   1. Joint Sealant: Single-component neutral-curing silicone sealant **ES-1**.
   2. Joint Sealant Color: Selected by Architect from manufacturer's full range of colors.

H. Joint Sealant Application **JS-3**: Interior porcelain tile expansion, control, contraction, and isolation joints in horizontal traffic surfaces.
   1. Joint Sealant: Single-component mildew resistant neutral-curing silicone sealant **ES-2**.
   2. Joint Sealant Color: Selected by Architect from manufacturer's full range of colors.

I. Joint Sealant Application **JS-4**: Interior joints between plumbing fixtures and adjoining walls, floors and counters.
   1. Joint Sealant: Single-component mildew resistant neutral-curing silicone sealant **ES-2**.
   2. Joint Sealant Color: Selected by Architect from manufacturer's full range of colors.

J. Joint Sealant Application **JS-5**: Vertical joints on exposed surfaces of interior unit masonry.
   1. Joint Sealant: Single-component non-sag urethane sealant **ES-1**.
   2. Joint Sealant Color: Selected by Architect from manufacturer's full range of colors.

K. Joint Sealant Application **JS-6**: Vertical joints on exposed surfaces drywall partitions.
   1. Joint Sealant: Single-component nonsag urethane sealant **ES-1**.
   2. Joint Sealant Color: Selected by Architect from manufacturer's full range of colors.

L. Joint Sealant Application **JS-7**: Perimeter joints between interior wall surfaces and frames of interior doors and windows.
   1. Joint Sealant: Latex Sealant **LS-1**.
   2. Joint Sealant Color: Selected by Architect from manufacturer's full range of colors.

3.05 FIELD QUALITY CONTROL

A. Owner may employ an independent testing agency to perform field quality control inspection and testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

C. Repair destructive test location damage immediately after evaluation and recording of results.

3.06 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

C. Thermally insulated hollow metal doors with frames.

D. Hollow metal borrowed lites glazing frames.

E. Accessories, including glazing.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.

B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.

C. Section 09 9000 - Painting and Coating: Field painting.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.

C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.

I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

J. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.

K. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2006.

L. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

M. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.

N. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

E. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
   2. Republic Doors: www.republicdoor.com.
   3. Steelcraft: www.steelcraft.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 1 - Standard-duty.
      b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 20 gage, 0.032 inch (0.8 mm), minimum.
   2. Core Material: Polyurethane.
   3. Door Thickness: 1-3/4 inch (44.5 mm), nominal.
   4. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
   5. Weatherstripping: Refer to Section 08 7100.
   6. Door Finish: Factory primed and field finished.

B. Interior Doors, Non-Fire Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 1 - Standard-duty.

b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 20 gauge, 0.032 inch (0.8 mm), minimum.

2. Core Material: Kraftpaper honeycomb.
3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
4. Texture: Smooth faces.
5. Door Finish: Factory primed and field finished.

C. Interior Smoke and Draft Control Doors (Indicated as "S" on Drawings): Same fire rated construction as the fire-rated doors, and the following;
1. Maximum Air Leakage: 3.0 cfm/sq ft (0.01524 cu m/sec/sq m) of door opening at 0.10 inch w.g. (24.9 Pa) pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
2. Gasketing: No added gasketing or seals allowed.
3. Label: UL "S" label.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. General:
1. Comply with the requirements of grade specified for corresponding door.
a. ANSI A250.8 Level 3 Doors: 14 gage frames. Exterior Frames
b. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 - SDI-100, Level 1, 18 gage, 0.042 inch (1.0 mm)

C. Exterior Door Frames: Full profile/continuously welded type.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
2. Frame Finish: Factory primed and field finished.
3. Weatherstripping: Separate, see Section 08 7100.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
1. Frame Finish: Factory primed and field finished.

E. Door Frames, Fire-Rated: Full profile/continuously welded type.
1. Fire Rating: Same as door, labeled.
2. Frame Finish: Factory primed and field finished.

F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

G. Mullions for Pairs of Doors: Fixed, with profile similar to jambs.

H. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

2.05 ACCESSORIES

A. Glazing: As specified in Section 08 8000, factory installed.

B. Astragals for Double Doors: Specified in Section 08 7100.

C. Grout for Frames: Portland cement grout with maximum 4 inch (102 mm) slump for hand troweling; thinner pumpable grout is prohibited.

D. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

E. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.06 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

E. Install door hardware as specified in Section 08 7100.

F. Comply with glazing installation requirements of Section 08 8000.

G. Touch up damaged factory finishes.

3.04 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; fire rated and non-rated.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames.

B. Section 08 7100 - Door Hardware.

C. Section 08 8000 - Glazing.

D. Section 09 2116 - Gypsum Board Assemblies:

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.

C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

D. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
   1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

D. Samples: Submit two samples of door construction, 6 by 6 inch (____ by ____ mm) in size cut from top corner of door.

E. Samples: Submit two samples of door veneer, 6 by 6 inch (____ by ____ mm) in size illustrating wood grain, stain color, and sheen.

F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

G. Manufacturer's Installation Instructions: Indicate special installation instructions.

H. Specimen warranty.

I. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
   1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

C. Quality Certification:
   1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.

4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging. Inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Interior Doors: Provide manufacturer's warranty for 2 years.

C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Graham Wood Doors: www.grahamdoors.com.
   2. ASSA Abloy Wood Doors: www.assaabloywooddoors.com.
   3. Eggers Industries: www.eggersindustries.com.
   4. Haley Brothers: www.haleybros.com.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS

A. Doors: Refer to drawings for locations and additional requirements.
   1. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
   3. Wood veneer facing with factory transparent finish Walnut, Rift Cut, Custom Stained to match Architects sample.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Walnut, veneer grade in accordance with quality standard indicated, rift cut, with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.

B. Facing Adhesive: Type I - waterproof.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:
   1. Provide solid blocks at lock edge for hardware reinforcement.
   2. Provide solid blocking for other throughbolted hardware.

C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.

D. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

G. Provide edge clearances in accordance with the quality standard specified.

2.06 FACTORY FINISHING - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 3, Lacquer, Postcatalyzed. Two Coats
      b. Stain: Match Architects Sample
      c. Sheen: Match Architects sample.

B. Factory finish doors in accordance with approved sample.

C. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

A. Hollow Metal Door Frames: As specified in Section 08 1113.

B. Glazing Stops in Non-Rated Doors: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

C. Glazing Stops in Rated Doors: Steel, painted finish, prepared for countersink style tamper proof screws.

D. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.

E. Astragals for Fire-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Coordinate installation of doors with installation of frames and hardware.

D. Coordinate installation of glazing.

E. Install door louvers plumb and level.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION

SECTION 08 3100 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall and ceiling access door and frame units.

1.02 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

1.03 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

D. Manufacturer's Installation Instructions: Indicate installation requirements.

E. Project Record Documents: Record actual locations of each access unit.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

2.02 WALL AND CEILING MOUNTED UNITS

A. Manufacturers:
   1. ACUDOR Products Inc: www.acudor.com/#sle.
   2. **Basis of Design**: Nystrom, Inc: www.nystrom.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
   1. Material: Steel.
   2. Door Style: Single thickness with rolled or turned in edges.
   3. Frames: 16 gage, 0.0598 inch (1.52 mm), minimum thickness.
   4. Single Steel Sheet Door Panels: 1/16 inch (1.6 mm), minimum thickness.
   5. Frames and flanges: 0.058 inch (1.5 mm) steel.
   6. Door panels: 0.070 inch (1.8 mm) single thickness steel sheet.
   7. Door panels: 0.070 inch (1.8 mm) double sheet with integral non-combustible insulation filler. Where indicated insulated.
   8. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
   9. Steel Finish: Primed.
   10. Primed and Factory Finish: Polyester powder coat; color to match adjacent wall or ceiling paint color, unless otherwise indicated..
   11. Size: As indicated, or required.
   12. Hardware:
      a. Hardware for Fire-Rated Units: As required for listing.
      b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
      c. Hinge: Non-Fire-Rated Units: 175 degree steel hinges with removable pin.
      d. Latch/Lock: Screw driver slot for quarter turn cam latch.
      e. Gasketing: Extruded neoprene, around perimeter of door panel. Required where indicated on Drawings.
   13. Prime coat with alkyd primer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 3323 - OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior coiling doors.

B. Overhead coiling doors, operating hardware, non-fire-rated and exterior, electric operation.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware: Keyed pad Locks.

B. Section 26 0583 - Wiring Connections: Power to disconnect.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ITS (DIR) - Directory of Listed Products; current edition.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).

G. NEMA MG 1 - Motors and Generators; 2014.

H. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

I. UL (EAUED) - Electrical Appliance and Utilization Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures.

B. Product Data: Provide general construction, electrical equipment, and component connections and details.

C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

D. Samples: Submit two slats, 6 x 6 inch (152 x 152 mm) in size illustrating shape, color and finish texture.

E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience.

C. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work

1.06 DESIGN/PERFORMANCE REQUIREMENTS

A. Overhead coiling service doors:
   1. Wind Loads: Design door assembly to withstand wind/suction load of 20 psf (958 Pa) without damage to door or assembly components in conformance with ASTM E 330.
   2. Operation: Design door assembly, including operator, to operate for not less than 500,000 cycles

B. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.07 DESIGN, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

C. Store materials in a dry, warm, ventilated weathertight location

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits

1.09 COORDINATION

A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials

1.10 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Warranty: Manufacturer’s limited door and operator system, to be free from defects in materials and workmanship for 3 years or 500,000 cycles, whichever occurs first.

C. PowderGuard Finish
   1. PowderGuard Max: Applied to curtain, guides, bottom bar, headplates: Manufacturer’s limited Max Finish warranty for 5 years

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Overhead Coiling Doors:
   1. Cornell Iron Works, Inc; Extreme 300 Series High Performance Door: www.cornelliron.com/#sle.
   2. The Cookson Company; Extreme 300 Series High Performance Door: www.cooksondoor.com/#sle.
   3. Basis of Design: Overhead Door Corporation; Product [Everserve - Model 625S]: www.overheaddoor.com.
   4. Wayne-Dalton, a Division of Overhead Door Corporation; High Cycle Rolling Service Doors Model 800 HC Sprinless: www.wayne-dalton.com/#sle.
   5. Or prior approved equal.

2.02 SPRINGLESS ROLLING SERVICE DOORS

A. Basis of Design: EverServe Model 625S Insulated Springless Rolling Service Doors with Stormtite perimeter seals by Overhead Door Corporation.
   1. Curtain: Interlocking roll-formed metal slats as specified with endlocks attached to each end of alternate slats to prevent lateral movement.

a. Flat Profile insulated type F-265i with 24 gauge back covering steel or stainless steel; .024 inch (.06 mm) aluminum, for doors up to 20 feet wide fabricated of:
   1) 24 gauge powder coated steel.
b. Insulation: Slat cavity shall be filled with CFC-free, foamed-in-place, polyurethane insulation.

2. Performance:
   a. R-Value: 7.7, U-Value: 0.13.
   b. Through Curtain Sound Rating: Sound Rating: STC-28 (STC-30+ with HZ noise generator) as per ASTM E 90.
   c. Installed System Sound Rating: STC-21 as per ASTM E 90.
   d. U-factor: 0.91 NFRC test report, maximum U-factor of no higher than 1.00.
   e. Air Infiltration: Meets ASHRAE 90.1 & IECC 2012/2015 C402.4.3 Air leakage < 1.00 cfm/ft2.
3. Curtain and Hood Finish:
   a. Galvanized Steel: Slats and hood galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat.
      1) Powder Coat:
         (a) PowderGuard Max powder coat, color as selected by Architect from full range.
      2) Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.
4. Weatherseals:
   a. Vinyl bottom seal, exterior guide and internal hood seals.
   b. Interior guide weatherseal.
   c. Lintel weatherseal.
5. Bottom Bar: Two metal angles, minimum thickness 3/16 inch, bolted back to back to reinforce curtain in the guides.
   a. Material:
      1) Steel.
6. Guides: Three Structural steel angles provided with high usage guide wear strip to minimize wear and reduce sound.
   a. Material:
      1) Steel.
      2) High usage guide wear strips.
7. Brackets:
   a. Hot rolled prime painted steel to support counterbalance, curtain and hood.
8. Finish; Bottom Bar, Guides, Headplate and Brackets:
   a. Finish: PowderGuard Max powder color as selected by the Architect from full range.
9. Motor: Direct drive, integrated gear motor/brake assembly sized for openings. Provide with a manual hand chain for operation during power outages. Operator and drive assembly is factory pre-assembled and provided with all wiring harnesses needed direct from the factory.
   a. Electrical Characteristics: 220V AC, single phase per motor/drive.
   b. Left hand mount.
10. Control Panel: Electronic controller with microprocessor self-diagnostics. Digital readout indicates door action, alarm conditions and fault conditions. Time delay self-close timer and non-resettable cycle counter are included. Enclosure is IP54 rated (NEMA 3 equivalent).
11. Door Roll: Directly driven, springless roll shall be steel tube with integral shafts, keyed on the Drive End and supported by self-aligning greaseable sealed bearings. Door shall not require any counterbalance device.
12. Hood: Protecting drive motor, barrel, chain, and sprocket from dirt and debris and extending between the support brackets. Provide with internal hood baffle weatherseal. Fabricated of:

a. 24 gauge galvanized steel with intermediate supports as required.
b. Provide with sloped hood and endcovers for exterior mounting.

13. Safety Devices: Provide door with following safety devices:
    a. Photoelectric sensors that cast an invisible beam across the door opening and reverses the downward motion of the door when an object enters the path of the beam.
    b. Built-in (to motor assembly) brake mechanism eliminates uncontrolled curtain travel independent of other safeties.
    c. Sensing Edge Protection (option; not standard)
        1) Electric sensing edge.
14. Actuators:
    a. One Open/Close/Stop push button station incorporated into Control Panel.
    b. Radio control.
    c. Interior Push buttons.
    d. Exterior Push buttons.
    e. Interior Key switch.
    f. Exterior Key switch.
    g. Loop detectors.
    h. Motion detectors.
    i. Warning light.
15. Windload Design:
    a. Standard windload shall be 20 PSF

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Verify that opening sizes, tolerances and conditions are acceptable.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Section 26 0583.

F. Complete wiring from disconnect to unit components.

G. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 9200 Joint Sealants.

H. Install perimeter trim and closures.

3.04 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16 inch (1.6 mm).

C. Maximum Variation From Level: 1/16 inch (1.6 mm).

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft (3.2 mm per 3 m) straight edge.

3.05 ADJUSTING

A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion

B. Adjust operating assemblies for smooth and noiseless operation.

3.06 CLEANING

A. A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.

B. Remove labels and visible markings.

C. Touch-up, repair or replace damaged products before Substantial Completion.

D. Protect installed products until completion of project.

END OF SECTION

SECTION 08 3616.13 - EXAM BARN (SLIDING) DOOR

PART 1 GENERAL

1.01 SUMMARY

A. Exam Barn (Sliding) Doors - Flush wood, and wood stile and rail with glass, aluminum frames and related hardware.

1.02 RELATED SECTION

A. Section 08 1416 - Flush Wood Doors

1.03 SUBMITTALS

A. Comply with Section 01 3000 - Submittal Procedures

B. Product Data: Submit manufacturer’s product data, including installation instructions.

C. Shop Drawings: Submit manufacturer’s shop drawings, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, components, hardware, finish, options, and accessories. Shop Drawings to show required blocking by others.

D. Samples: Submit manufacturer’s samples of the following sliding door components:
   1. Door veneer or laminate sample
   2. Aluminum Frame finish sample

E. Manufacturer’s Certification: Submit manufacturer’s certification that materials comply with specified requirements and are suitable for intended application.

F. Warranty Documentation: Submit manufacturer’s standard warranty.

G. Test Reports: Submit acoustical reports or UL1784 as applicable.

1.04 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of interior aluminum frames and doors.

B. Manufacturer's Qualifications: Manufacturer regularly engaged for past 5 years in manufacture of sliding doors similar to that specified.

1.05 REFERENCES

A. ANSI - American National Standards Institute
   1. ANSI 156.18 Materials and Finishes
   2. ANSI A117.1 Specifications for making buildings and facilities usable by physically handicapped people.

B. BHMA - Builders Hardware Manufacturers Association

C. DHI - Door and Hardware Institute

D. NFPA - National Fire Protection Association
   1. NFPA 80 - Fire Doors and Windows
   2. NFPA 101 - Life Safety code
   3. NFPA 105 - Smoke and Draft Control Door Assemblies
   4. NFPA 252 - Fire Tests of Doors Assemblies

E. AWS - Architectural Woodwork Standards

1.06 PERFORMANCE

A. Aluminum perimeter frames with integral acoustic seals

B. Soft self-closing mechanism integrated with top track

C. Concealed door guide

1.07 DELIVERY, STORAGE AND PROTECTION

A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Notify manufacturer immediately of any shipping damage.

C. Storage and Handling Requirements:
   1. Store and handle materials in accordance with manufacturer's instructions.
   2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
   3. Store materials in clean, dry area indoors.
   4. Protect materials and finish during storage, handling, and installation to prevent damage.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. AD SYSTEMS 2201 100th St. SW, Everett, WA 98204 | Website: http://specADsystems.com | Phone: 425-374-1360 | Attn: Estimating: estimating@specADsystems.com

2.02 INTERIOR SLIDING ALUMINUM-FRAMED DOORS AND PARTITIONS

A. Interior Aluminum-Framed Top-Hung Sliding Doors: Model: ExamSlide™ High Performance Barn (Sliding) Door System by AD Systems.

B. Specified Wall Thickness: Refer to floor plan wall types, indicated in Drawings.

C. Frame Profiles: Extruded aluminum frame "wrap" frame with integral vertical jamb (stile pocket).
   1. Finish:
      a. Class I Natural Anodized.

D. Door Leafs. All Doors to be factory machined for hardware including pilot and function holes.
   1. 1-3/4" Flush Wood Door: Reference Spec Section 08 1416 Flush Wood Doors.
      a. Optional Glazing: Safety laminated glass, sound enhanced laminated glass.
   2. Stile and Rail Wood Doors:
      a. Note: Stile widths are 6" with a 10" bottom rail
      b. Match finish on flush wood doors.
      c. Glazing: Sound enhanced laminated glass.

E. Door Components:
   1. Single Top Track: AD Systems extruded aluminum track by AD Systems
   2. Valances: Extruded aluminum with integral end caps
      a. Standard square valance
   3. Top Rollers: tandem nylon roller sized to match door weight
   4. Concealed Floor Guide: Integral Jamb floor guide by AD Systems
   5. Soft-Closer: Soft and self-closing damper mechanism at both sides of door leaf
   6. Handles:
      a. AD Systems Standard Ladder Pull: 16" long x 1" diameter. Finish: US32D Satin Stainless Steel, where Cylinder & Small Formate Inner Core is NOT indicated in the hardware specification schedule.

F. Accessories:
   1. Door Locks:
      a. Mortise Latch and Lock Options: Contact AD Systems for assistance
         1) Standard ADA-1 Thumbturn with Key Lock & 16-inch Ladder Pull. Mortise latch to accommodate Cylinder & Small Format Inter Core provided by hardware supplier, where indicated on Hardware Specification Schedule.
   2. Automatic Door Bottom for improved acoustical performance

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine wall openings to receive sliding doors for plumb, level, and square. Note: Finish door operation will be affected by out of tolerance framing.

B. Verify dimensions of wall openings.

C. Examine surfaces to receive top and bottom guide.

D. Notify Architect of conditions that would adversely affect installation or subsequent use of sliding doors.

E. Do not begin installation until unacceptable conditions are corrected.

F. Base of door side to be flush or minimal. Rubber Base acceptable.

3.02 INSTALLATION

A. Install sliding doors in accordance with manufacturer's instructions at locations indicated on the Drawings.

B. Install sliding doors plumb, level, square, and in proper alignment.

C. Install sliding doors to close against walls without gaps

D. Install sliding doors to open and close smoothly.

E. Anchor sliding doors securely in place to supports. Required: Fire treated 2 x 6 blocking required full length of track.

3.03 ADJUSTING

A. Adjust sliding doors for proper operation in accordance with manufacturer's instructions.

B. Adjust sliding doors to operate smoothly without binding.

C. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

3.04 CLEANING

A. Clean sliding doors promptly after installation in accordance with manufacturer's instructions.

B. Do not use harsh cleaning materials or methods that could damage materials or finish.

3.05 PROTECTION

A. Protect installed sliding doors from damage during construction.

SECTION 08 4126 - ALL-GLASS ENTRANCES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Refer to Division 01 Section "Project Requirements".

1.03 SUBMITTALS

A. Product Data: For each type of all-glass entrance component specified. Details of construction relative to materials, dimensions of individual components, profiles, and finishes, including:
   1. Glass panels.
   2. Rail and Patch fittings.
   3. Closer and pivots.
   4. Door hardware and accessories.

B. Shop Drawings: Show details of fabrication and installation, including the following:
   1. Plans, elevations, and sections.
   2. Details of fittings.
   3. Hardware quantities, locations, and installation requirements.
   4. Anchorages and reinforcement.
   5. Glazing details.
   6. Door hardware locations, mounting heights, and installation requirements.

C. Samples for Verification: For each type of exposed finish indicated, prepared on Samples of size indicated below as required by Architect.
   1. Metal Finishes: 6-inch (150-mm) long sections of rail fittings.
   2. Glass: 12-inch (300 mm) square, showing exposed-edge finish and tint.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, sidelites, transoms, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

E. Maintenance Data: For all-glass systems to include in maintenance manuals.

1.04 PROJECT CONDITIONS

A. Field Measurements: Verify opening dimensions of all-glass entrances by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.05 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of all-glass entrances that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
   1. Structural failures.
   2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   3. Failure of operating components to function normally.

C. General Warranty Period: Two years from date of Substantial Completion.
   1. Concealed Floor Closers: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design all-glass entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of all-glass entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

C. Structural Loads:
   1. Wind Loads: As indicated on Drawings.
   2. Other Design Loads: As indicated on Drawings
   3. Deflection Limits: In accordance with GANA “Fully Tempered Heavy Glass Door and Entrance Systems Design Guide.”

D. Seismic Performance: All-glass entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. Coordinate requirements with structural engineer.

E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

F. Accessibility Standards: Comply with applicable provisions in Accessibility Guidelines for Buildings and Facilities ICC (ANSI) A117.1 and requirements of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide the named product, or the comparable product by one of the alternate specified manufacturers. Comparable products are subject to review and approval through the submittal process specified.

B. Manufacturers (All Glass Doors): Subject to compliance with requirements, provide products by one of the following:
   1. ASSA ABLOY Glass Solutions (All Glass Door components).
   2. Trulite Glass and Aluminum Solutions.
   3. Virginia Glass Products Corporation.

2.03 ENTRANCE DOOR MATERIALS

A. Clear Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), Class 1 (clear) requirements. Provide products of thickness indicated that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to CPSC 16 CFR, Part 1201 for Category II materials.
   1. Thickness: 1/2 inch (13 mm)
   2. Exposed Edges: Flat polished.
   3. Butt Edges: Flat polished.
   4. Corner Edges: Mitered.

B. Stainless-Steel Cladding: ASTM A 666, Type 302 or Type 304.

2.04 ENTRANCE DOOR COMPONENTS

A. Floating Transom Bar: Manufacturer's standard aluminum, floating transom bar clad in metal matching fittings in size recommended by manufacturer for application indicated.
   1. Support Fins: Tempered glass matching the transom glass.

B. Sidelite Channels: Provide manufacturer's standard head and sill channels for sidelite and transom-head support matching fitting-metal finish, unless otherwise indicated.

C. Concealed Sidelite Channels: Provide manufacturer's standard recessed head and sill channels for concealed sidelite and transom-head support, unless otherwise indicated.

D. Rails: Manufacturer's standard continuous horizontal fittings and as follows:
   1. Rail Locations: As follows:
      a. Door tops and bottoms.
      b. Transom tops. Provide with manufacturer's standard fixed-mounting system.
      c. Sidelite tops. Provide with manufacturer's standard fixed-mounting system.
      d. Sidelite bottoms. Provide with manufacturer's standard fixed-mounting system.
   2. Top Rail Height: 4 inch tapered (102 mm).
   3. Top Rail Profile: Square.
   4. Bottom Rail Height: 10 inch (254 mm).
   5. Bottom Rail Profile: Tapered no less than 60 degrees from horizontal.
   6. One piece dry glazed compression system that accommodates 3/8” to 9/16” or 5/8” to 13/16” thick glass.
   7. End Caps: One-piece solid stainless steel, beveled.
   8. Material: Aluminum.
   9. Material: Bright or satin stainless-steel-cladding.
   10. Basis of Design: ASSA ABLOY Glass Solutions #DRT/DRS x Height.

E. Accessory Fittings: Manufacturer's standard accessory fittings matching patch fitting or rail metal and finish for the following:
   1. Overhead doorstop.
   2. Center-housing lock.
   3. Glass-support fins.

F. Anchors and Fastenings: Manufacturer's standard concealed anchors and fastenings.

G. Weather Stripping; Brush type; replaceable without removing all-glass entrance doors from pivots.

2.05 ENTRANCE DOOR HARDWARE

A. General: Heavy-duty entrance door hardware units in sizes, quantities, and types recommended by manufacturer for all-glass entrance systems indicated. For exposed parts, match metal and finish of patch fittings and rail fittings.

B. Refer to section 080671 “Door Hardware Schedule” for specific hardware sets.

C. Locking Pull System: Post-mount style door pulls with integrated deadbolt locking system in type and design as specified in the Hardware Sets. Pulls available in multiple head, floor, or combination locking and strike options, with outside keyed rim cylinder operation and inside turn piece activation. Customized sizing and configuration options.
   1. Manufacturers:
      a. ASSA ABLOY Glass Solutions (GS) - LP/DP Series.
      b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO) - LP/DP Series.

2.06 FABRICATION

A. General: Fabricate all-glass entrance components in sizes, profiles, and configurations indicated on Drawings.

B. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.
   1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

C. Factory assemble components and factory install hardware and fittings to greatest extent possible.

2.07 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

2.08 STAINLESS-STEEL FINISHES

A. Remove or blend tool and die marks and stretch lines into finish.

B. Grind and polish surfaces to produce uniform, directional textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Bright, Directional Polish: No. 4 finish.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clear.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 DOOR INSTALLATION

A. General: Comply with all-glass entrance manufacturer's written installation instructions and approved shop drawings.

B. Install all-glass door assemblies after other finishing operations have been completed. Coordinate installation of recesses housings with installation of adjacent finishes.

C. Set units level, plumb, and true to line, with uniform joints.

D. Maintain uniform clearances between adjacent components.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

F. Install butt-joint sealants according to manufacturer's instructions and as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

3.03 ADJUSTING AND CLEANING

A. Adjust all-glass entrance doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

3.04 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure all-glass entrances are without damage or deterioration at the time of Substantial Completion.

3.05 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
   1. Quantities listed are for each pair of doors, or for each single door.
   2. The supplier is responsible for handing and sizing all products.
   3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Refer to Section 08 7100 Door Hardware for hardware sets.

END OF SECTION

SECTION 08 4229 - AUTOMATIC ENTRANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged power-operated door assemblies of following types:
   1. Sliding type.

B. Automatic sliding doors, with frames.

C. Controllers, actuators and safety devices.

1.02 RELATED REQUIREMENTS

A. Section 26 0583 - Wiring Connections.

B. Section 28 4600 - Fire Detection and Alarm: Connection to fire alarm system.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. BHMA A156.10 - American National Standard for Power Operated Pedestrian Doors; 2011.

C. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2011.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NFPA 101 - Life Safety Code; 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Shop Drawings:
   1. Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.
   2. Identify installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.

C. Product Data: Provide data on system components, sizes, features, and finishes.

D. Samples: Submit two samples of exposed to view hardware, carpet with frame, and attachment hardware.

E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and manufacturer's hardware and component templates.

F. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

G. Maintenance Data: Include manufacturer's parts list and maintenance instructions for each type of hardware and operating component.

H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Wrenches and other tools required for maintenance of equipment.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty for motor and compressor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sliding Automatic Entrance Door Assemblies:

1. ASSA ABLOY Entrance Solutions; Besam Resilience Non-Impact (hurricane resistant): www.besam-usa.com.
2. Horton Automatics: www.hortondoors.com.
3. NABCO Entrances Inc; GT 1175 Whisper Slider: www.nabcoentrances.com/#sle.
4. Stanley Access Technologies; Dura-Storm 3000: www.stanleyaccesstechnologies.com/sle.
5. Or prior approved equal.

2.02 POWER OPERATED DOORS

A. Power Operated Doors: Provide products that comply with NFPA 101 and requirements of authorities having jurisdiction; provide equipment selected for actual door weight and for light pedestrian traffic, unless otherwise indicated.
   1. Sliding and Folding Door Operators: In the event of power failure, provide for manual open, close, and break-away operation of door leaves.
   2. Packaged Door Assemblies: Provide components by single manufacturer, factory-assembled, including doors, frames, operators, actuators, and safeties.
      a. Finish exposed equipment components to match door and frame finish.

B. Sliding with Full Power Operators: Comply with BHMA A156.10; safeties required; provide break-away operation unless otherwise indicated; in the event of break-away operation, interrupt power operation.

2.03 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

A. Comply with ADA Standards for egress requirements.

B. Sliding Automatic Door: Bi-parting double leaf track-mounted, electric operation, extruded aluminum glazed door, with frame, and operator concealed overhead.
   1. Operation: Power open, power boost operation.
   2. Actuator(s): As indicated on drawings.
   3. Exterior-Side Actuator/Safety: Motion sensor.
   4. Interior-Side Actuator/Safety: Motion sensor.
   5. Hold Open: Toggle switch at inside head of doors; this is not a fire-rated door.
   6. Door and Frame Finish: Anodized, natural.

2.04 DOOR OPERATORS

A. Door Operators - General Requirements: Comply with BHMA A156.10, BHMA A156.19, and UL 325, as applicable.
   1. Select equipment to accommodate heavy pedestrian traffic and weight of doors.
   2. Provide equipment capable of operating, holding open, and closing doors under positive and negative wind pressures calculated in accordance with applicable code.
   3. Operating Temperature Range: Minus 20 to plus 140 degrees F (minus 7 to plus 60 degrees C) ambient.
   4. Provide operators that are fully adjustable for opening and closing speeds, checking speeds, and hold-open time.
   5. Sliding Door Operators: Provide for manual open, close, and break-away operation of door leaves in the event of power failure. Maximum Force for Break-Away Function: 15 lbf (____ N).
   6. Conform to applicable code for automatic release of control drive unit to permit manual opening of doors.
   7. Finish exposed components to match door and door hardware finish.
   8. Electric Operators: 1.5 hp (____ W) minimum, self-contained, chain driven, with release clutch.

2.05 ACTUATORS

A. Proximity Detector Actuator/Safety: Microwave; distance of control sensitivity adjustable.
   1. Operation Zone: 60 inch (____ mm) long by 84 inch (____ mm) wide by 60 inch (____ mm) deep and 24 inch (____ mm) above floor.
   2. Safety Zone: Same dimensions as operating zone.

B. Push Button Actuator: Standard momentary contact type, wall mounted, surface; stainless steel escutcheon plate.

2.06 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics:
   1. 120 volts, single phase, 60 Hz.

B. Motors: NEMA MG 1.

C. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

D. Disconnect Switch: Factory mount disconnect switch in control panel.

2.07 ACCESSORIES

A. Steel Clips, Supports, and Steel Anchors: Galvanized to 1.25 oz/sq ft (380 g/sq m).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.

B. Verify that electric power is available and is of the correct characteristics.

3.02 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Provide for thermal expansion and contraction of door and frame units and live and dead loads that may be transmitted to operating equipment.

C. Provide for dimensional distortion of components during operation.

D. Install pneumatic lines and door power units in a manner to prevent condensation or freezing.

E. Coordinate installation of components with related and adjacent work; level and plumb.

3.03 ADJUSTING

A. Adjust door equipment for correct function and smooth operation.

3.04 CLEANING

A. Remove temporary protection, clean exposed surfaces.

3.05 CLOSEOUT ACTIVITIES

A. Demonstrate operation, operating components, adjustment features, and lubrication requirements.

END OF SECTION

SECTION 08 4243 - INTENSIVE CARE UNIT AUTOMATIC FOLDING ENTRANCES

PART 1 GENERAL

1.01 SUMMARY

A. This section includes the following types of intensive care unit/critical care unit (ICU/CCU) entrance doors:
   1. Swing / bi-fold combination ICU/CCU entrance
   2. Bi-fold ICU/CCU entrance.

B. Related Sections:
   1. Division 7 Sections for caulking to the extent not specified in this section.
   2. Division 8 Section “Glazing” for materials and installation requirements of glazing for ICU/CCU entrance doors.

1.02 REFERENCES

A. References: Refer to the version year adopted by the Authority Having Jurisdiction.
   1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
   2. ICC/IBC - International Building Code.
   3. NFPA 70 - National Electrical Code.
   4. NFPA 101 - Life Safety Code.
   5. [NFPA 105 - Installation of Smoke Door Assemblies.]

B. American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA).
   1. ANSI Z97.1 Standards for Safety Glazing Material Used in Buildings.

C. [Underwriters Laboratories (UL).]
   1. [UL 1784 – Air Leakage Tests of Door Assemblies.]

D. American Society for Testing and Materials (ASTM).
   1. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
   2. ASTM B209 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

E. American Architectural Manufacturers Association (AAMA).
   1. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.

F. National Association of Architectural Metal Manufacturers (NAAMM).
   1. Metal Finishes Manual for Architectural Metal Products.

G. International Code Council (ICC).
   1. [IBC: International Building Code.]
   2. [CBC: California Building Code.]

1.03 PERFORMANCE REQUIREMENTS

A. Compliance with the following:

B. [MicroShieldTM antimicrobial silver-based ion finish on all exposed surfaces including door pulls, door extrusions, rails and header to comply with the manufacturer’s specified requirements.]
   1. Antimicrobial finish must permanently suppress the growth of bacteria, algae, fungus, mold and mildew.

1.04 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, fabrication, operational descriptions and finishes.

B. Shop Drawings: Submit manufacturer’s shop drawings, including elevations, sections and details, indicating dimensions, materials, and fabrication of doors, frames, sidelites, hardware, finish, options and accessories.

C. Samples: Submit manufacturer’s samples of aluminum finish.

D. Informational Submittals: Manufacturer's product information and applicable sustainability program credits that are available to contribute towards a LEED rated project certification.
   1. Credit MR 4.1 and 4.2: Manufacturer's or fabricator's certificate indicating percentage of post-consumer recycled content by weight and pre-consumer recycled content by weight for each Product specified under this Section.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door opening installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the entrance and their nearest service representatives. The final copies delivered after completion of the installation test to include spare parts list.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.05 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 10 years of documented experience in manufacturing of doors and equipment of similar to that indicated for this Project and that have a proven record of successful in-service performance. Manufacturer to have a company certificate issued by AAADM.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 5 years documented experience installing and maintenance of units similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Source Limitations for ICU/CCU Entrances: Obtain each type of door, frame, operator and sensor components specified in this Section from a single source, same manufacturer unless otherwise indicated.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings to receive ICU/CCU entrances by field measurements before fabrication and indicate on shop drawings.

1.07 COORDINATION

A. Coordinate sizes and locations of recesses in concrete floors for recessed tracks and thresholds if applicable. Concrete work is specified in Division 03.

1.08 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. ICU/CCU entrances shall be free of defects in material and workmanship for a period of one (1) year from the date of substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Manufacturer: ASSA ABLOY Entrance Systems, 1900 Airport Road, Monroe, NC 28110. Toll Free (877) SPEC-123. Fax (704) 290- 5555 Website www.assaabloyentrance.us contact: specdesk.na.entrance@assaabloy.com

B. [Substitutions: Requests for substitution and product approval in compliance with the specifications must be submitted in writing and in accordance with the procedures outlined in Division 1, Section “Substitution Procedures”. Approval of requests is at the discretion of the architect, owner, and their designated consultants.]

C. [Substitutions: Not Permitted.]

2.02 INTENSIVE CARE UNIT/CRITICAL CARE UNIT (ICU/CCU) ENTRANCES

A. ICU/CCU entrances including the following:
   1. Swinging panels, bi-fold panels, and aluminum frame.
   2. Entrance header, guide system and carrier assemblies.

B. Besam ASSA ABLOY VersaMax® 2.0 ICU/CCU Fold Door Package (Basis of Design):
   1. [ICU/CCU 3 panel, non-latching folding/swing door system.]
      a. Operation: Manually operated, non-latching.
      b. Door Configuration: Double-acting swing door and a 2 panel bi-fold door combination.
         1) Swing Door: Non-latching, double-acting door with door closer.
         2) Bi-Fold Door: Non-latching, 2 panel, bi-fold door.
      c. Breakaway Capability: Bi-fold door to have break-out from any position.
      d. Mounting: Overhead header installed between jambs.
      e. Trackless Design: Floor mounted guide track not allowed.
   2. [ICU/CCU 3 panel, latching folding/swing door system.]
      a. Operation: Manually operated, latching.
      b. [Smoke Seals: Smoke gasketing that meets the infiltration requirements of UL1784.]
      c. Door Configuration: Directional swing door and a 2 panel bi-fold door combination.
         1) Swing Door: Latching, directional swing door with door closer.
         2) Bi-Fold Door: Latching 2 panel, bi-fold door.
      d. Breakaway Capability: Bi-fold door to have break-out from any position.
      e. Mounting: Overhead header installed between jambs.
      f. Trackless Design: Floor mounted guide track not allowed.
   3. [ICU/CCU 2 panel, folding door system.]
      a. Operation: Manually operated.
      b. Door Configuration: 2 panel bi-fold door.
      c. Breakaway Capability: Bi-fold door to have break-out from any position.
      d. Mounting: Overhead header installed between jambs.
      e. Trackless Design: Floor mounted guide track not allowed.
   4. [ICU/CCU 4 panel, folding door system.]
      a. Operation: Manually operated.
      b. Door Configuration: Two 2 panel bi-fold doors.
      c. Breakaway Capability: Bi-fold door to have break-out from any position.
      d. Mounting: Overhead header installed between jambs.
      e. Trackless Design: Floor mounted guide track not allowed.

2.03 ENTRANCE COMPONENTS

A. Stile and Rail Sliding/Swing/Folding Panels and Sidelites:
   1. Material: Extruded Aluminum, Alloy 6063-T5 or 6063-T6.
   2. Door panels shall have a minimum .125 inch (3.2 mm) structural wall thickness including adjoining perimeter frames where applicable.
      a. Aluminum extrusions shall allow for a factory installed, slide-in type gasket.
   3. Door Construction shall be by means of an integrated corner clip with 3/8 inch diameter all-thread through bolt from each stile.
      a. Face of door stiles shall be flush with adjacent rails and muntin.
   4. Glass stops shall be .062 inch (15.8 mm) wall thickness and shall provide security function as a standard by means of a fixed non-removable exterior section with glazing to be performed from the interior only.
      a. [Beveled glass stops.]
   5. Vertical Stiles shall be narrow stile 2-1/8 inch (54 mm).
   6. Top Rail shall be 4 inch (102 mm).
   7. Bottom Rails shall be [4 inch (102 mm).] [7 inch (178 mm).] [10 inch (254 mm).]
   8. [Intermediate Muntin shall be [1-3/4 inch (45 mm).] [4 inch (102 mm).]
   9. [Gasketing: Slide-in type, replaceable pile mohair seals.]
      a. Bottom rails shall be provided with a concealed adjustable sweep gasket.

10. [Smoke Gasketing: Slide-in type, replaceable, smoke type gasket that is capable of withstanding 400o F for a minimum of 30 minutes.]
    a. Bottom rails shall be provided with a concealed adjustable sweep gasket that is capable of withstanding exposure to 400o F for a minimum of 30 minutes.
11. Glass: Glazing for Sliding/Swing/Fold Panels and Sidelite Panels shall comply with ANSI Z97.1, thickness as indicated.
    a. Glazing: [1/4" (6 mm)] tempered glass, unless otherwise specified. [Optional glazing: 5/8" (16 mm) insulated glass, 1" (25 mm) insulated glass, 1-1/4" (31 mm) insulated glass]
        1) Glazing Installation: Dry glazing; wet glazing not allowed.
            (a) See manufacturer's instructions and Division 8 Section "Glazing" for requirements.
            (b) [All Glazing furnished "by others".]
    b. [Lower Lite Glazing Panels: 1" (25 mm) overall thickness frosted insulating glass unit consisting of an interior and exterior glass lite; both lites to be 1/4 inch (6 mm) tempered glass.]
        1) Frosted Glazing: Opaque, acid etched on #2 or #3 surface.
    c. [Upper Lite] Glazing with Integral Blinds: 1-1/4" (31 mm) overall thickness insulating glass unit consisting of an interior and exterior glass lite; both lites to be 1/4 inch (6 mm) tempered glass.]
        1) Integral Blinds: Glass to have blinds installed between glass lites.
            (a) Blinds to be mechanically gear-driven tilt micro-blind installed in the sealed insulating glass unit. Internally mounted control assembly that is coupled to the external operator controls the tilting of blind slats.
            (b) Tilt Operator: Thumb wheel, dual control.
        2) Glazing Installation: Dry glazing; wet glazing not allowed.
            (a) See manufacturer's instructions and Division 8 Section "Glazing" for requirements.

B. Framing Members: Provide ICU/CCU entrances as complete assemblies. Manufacturer's standard extruded aluminum framing reinforced as required to support loads.
    1. Vertical Jambs: [1-3/4 inches (44.5 mm)] [1 inch (25.4 mm)] by 4-1/2 inches (114.3 mm).]

C. Header: Extruded aluminum header with track surface mounted under header, extending full width of entrance unit.
    1. Header Capacity: Capable of supporting up to 115 pounds (52.2 kg) weight of swing door and up to 170 pounds (77.1 kg) weight of folding door(s).
        a. Size: 4-1/2 inches (114.3 mm) wide by 1-3/4 inches (44.5 mm) high.

2.04 HARDWARE

A. Hardware: Provide manufacturer's standard hardware as required for operation indicated.
    1. [Double-Acting Swing Door, Non-Latching:]
        a. Top and bottom pivots.
        b. Double acting door closer.
            1) [Door closer shall have a 90 degree hold open feature (hold open in both directions).]
        c. Manufacturer's surface-mounted, vertical C-shaped pull handles on both sides of door.
    2. [Directional Swing Door, Latching:]
        a. Top and bottom pivots.
        b. Door closer.
            1) [Door closer shall have a 90 degree hold open feature.]
        c. Latching Hardware: Concealed top and bottom vertical rods. Bottom rod to serve as a counter balance mechanism, factory adjusted so that it does not extend below the bottom of the rail.
            1) Push Side: Push paddle.
            2) Pull Side: Curved lever handle.

3. [Two Panel / Four Panel Bi-Fold Door(s), Non-Latching:]
    a. Top and bottom pivot(s).
    b. One (1) rubber (Hytrel) roller wheel on the slave leaf(s).
    c. Manufacturer's surface-mounted, vertical C-shaped pull handle(s) on pull side of door(s).
    d. Manufacturer's surface-mounted, horizontal push bar(s) on push side of door(s).
    e. Full height finger guard between folding door panels.
4. [Two Panel Bi-Fold Door(s), Latching:]
    a. Top and bottom pivot(s).
    b. One (1) rubber (Hytrel) roller wheel on the slave leaf(s).
    c. Manufacturer's surface-mounted, vertical C-shaped pull handle(s) on pull side of door(s).
    d. Manufacturer's surface-mounted, horizontal push bar(s) on push side of door(s).
    e. Full height finger guard between folding door panels.
5. Floor Mounted Guide Track/Threshold:
    a. Trackless Design: Floor mounted guide track and threshold not allowed.

2.05 ALUMINUM FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. [Anodized Finish:]
    1. [AAMA 611, Clear, AA- M12C22A41, Class I, 0.018 mm.]
    2. [AAMA 611, Dark Bronze, AA-M12C22A44, Class I, 0.018 mm.]
    3. [AAMA 611, Custom anodized to match architect's sample.]

C. [Painted Finish:]
    1. [Powder coat painted to match architect's sample.]
    2. [Kynar finish, [2 coat] [3 coat], to match architect's sample.]

D. [To match architects sample.]

E. [MicroShieldTM antimicrobial silver-based ion, baked-on enamel finish on all exposed surfaces including door pulls, door extrusions, rails and header.]
    1. Antimicrobial finish must permanently suppress the growth of bacteria, algae, fungus, mold and mildew by the controlled release of silver ions that attack microbes and inhibit the growth on the treated surfaces.
    2. Coating to be EPA registered resulting in a safe and non-toxic finish; chlorinated or synthetic chemical finishes will not be accepted.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance.

B. Proceed only after such discrepancies or conflicts have been resolved.

3.02 INSTALLATION

A. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.

B. Install intensive care unit/critical care unit (ICU/CCU) entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
    1. Install surface mounted hardware using concealed fasteners to greatest extent possible.
    2. Set headers, carrier assemblies, tracks, operating brackets and guides level and true to location with anchorage for permanent support.
    3. Where aluminum will contact dissimilar metals, concrete, or masonry, protect against galvanic action and corrosion.

4. [Where smoke control intensive care unit/critical care unit (ICU/CCU) entrances are installed in smoke barriers or partitions, set framing members and header in a bed of sealant to comply with NFPA 105.]

C. Glazing: Glaze intensive care unit/critical care unit (ICU/CCU) entrance door panels in accordance with the Glass Association of North America (GANA) Glazing Manual, published recommendations of glass product manufacturer, and published instructions of ICU/CCU entrance manufacturer.

D. Sealants: Comply with requirements specified in division 7 Section “Joint Sealants” to provide a weather tight installation.
   1. Set thresholds and framing members in full bed of sealant.
   2. Seal perimeter of framing members with sealant.

3.03 ADJUSTING

A. Adjust alignment of entrances and hardware for smooth, safe operation with minimum air infiltration.

B. Verify installation and alignment of all entrance gasketing as required for minimum air infiltration and compliance with specified standards.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door installation.

B. Clean glass and metal surfaces promptly after installation. Remove excess sealants, compounds, dirt and other substances. Repair damages to match original finish.

3.05 DEMONSTRATION

A. Engage a factory-authorized representative to train Owner's maintenance personnel to adjust, operate, and maintain safe operation of the door.

END OF SECTION

SECTION 08 4313 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Aluminum doors and frames.

C. Weatherstripping.

1.02 RELATED REQUIREMENTS

A. Section 07 1300 - Self-Adhered Sheet Membrane: Perimeter air and vapor barrier seal between glazing system and adjacent construction.

B. Section 07 2726 - Fluid Applied Non Permable Vapor Barriers

C. Section 07 8400 - Firestopping: Firestop at system junction with structure.

D. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

E. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.

F. Section 08 8000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

B. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.

C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.

D. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.

E. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.

F. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

I. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

J. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.

K. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).

L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

M. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures, for submittal of items required.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details .

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

F. Samples: Submit two samples 6 X 6 inches (____x____ mm) in size illustrating finished aluminum surface, glass, infill panels, glazing materials.

G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

B. Provide two year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

C. Provide two year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Kawneer North America; Product Exterior Storefront Product: Trifab VG 451T, Interior Storefront Product: Trifab 400.

B. Aluminum-Framed Storefront and Doors:
   1. YKK AP America Inc: www.ykkap.com.
   2. United States Aluminum Corp: www.usalum.com.
   3. Oldcastle BuildingEnvelope: www.oldcastlebe.com.
   4. Or prior approved equal.

2.02 STOREFRONT

A. Exterior Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Glazing Position: Centered (front to back).
   2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (50 mm wide by 114 mm deep).
      a. Locations: Typical for all storefront except where otherwise noted in Drawings.
   3. Vertical Mullion Dimensions: 2 inches wide by 6 inches deep
      a. Locations: At locations notes in Drawings and in locations where necessary to conceal or align with support structure for storefront system.
   4. Water Leakage Test Pressure Differential: min. 6.24 lbf/sq ft (____ Pa).
   5. Air Infiltration Test Pressure Differential: ____ psf (____ Pa).
   6. Finish: Superior performing organic coatings.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
   7. Finish Color: As selected by Architect from manufacturer's standard line.
   8. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   9. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   10. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   11. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
   12. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
   13. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Interior Aluminum Framed Storefront: Factory fabricated, factory finished Aluminum framing members with infill, achorage, and attachment devices.
   1. Glazing Position: Center
   2. Vertical mullion Dimensions: 1-3/4" x 4"
   3. Finish: Class II Natural Anodized

C. Performance Requirements:
   1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
      a. Design Wind Loads: Comply with requirements of applicable code.
      b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
   2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf (390 Pa).
   3. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft (0.3 L/sec sq m) of wall area, when tested in accordance with ASTM E283 at 6.27 psf (300 Pa) pressure differential across assembly.
   4. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.

5. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft (0.3 L/s/sq m) of wall area, measured at specified differential pressure across assembly in accordance with ASTM E283.
6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.

B. Glazing: As specified in Section 08 8000.

C. Exterior Doors: Glazed aluminum. Medium Stile Doors with 1" insulated glass.
   1. Thickness: 1-3/4 inches (43 mm).
   2. Top Rail: 4 inches (____ mm) wide.
   3. Vertical Stiles: 4 inches (____ mm) wide.
   4. Bottom Rail: 10 inches (254 mm) wide.
   5. Glazing Stops: Square.
   6. Finish: Same as storefront.

D. Interior Doors: Glazed aluminum. Narrow Stile Doors with 1" insulated glass.
   1. Thickness: 1-3/4 inches (43 mm).
   2. Top Rail: 2 1/8 inches (____ mm) wide.
   3. Vertical Stiles: 2 1/8 inches (____ mm) wide.
   4. Bottom Rail: 10 inches (254 mm) wide.
   5. Glazing Stops: Square.
   6. Finish: Same as storefront.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Perimeter Sealant: Type as specified in Section 07 9200.

D. Glass: As specified in Section 08 80 00.

E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

F. Glazing Accessories: As specified in Section 08 8000.

2.05 FINISHES

A. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils (0.01 mm) thick.

B. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch (0.030 mm).

C. Color: As selected by Architect from manufacturer's full range.

2.06 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.

B. Other Door Hardware: Provide all necessary hardware as needed to provide a complete functional and locking system unless hardware component is otherwise specified in Section 08 7100.

C. Other Door Hardware: Storefront manufacturer's standard type to suit application.
   1. Finish on Hand-Contacted Items: Polished chrome.
   2. For each door, include butt hinges, pivots, push handle, pull handle, exit device, narrow stile handle latch, and closer.

D. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

E. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.

F. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

2.07 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

E. Arrange fasteners and attachments to conceal from view.

F. Reinforce components internally for door hardware .

G. Reinforce framing members for imposed loads.

H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
   1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Coordinate attachment and seal of perimeter air and vapor barrier materials.

I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

J. Set thresholds in bed of sealant and secure.

K. Install glass and infill panels in accordance with Section 08 8000, using glazing method required to achieve performance criteria.

L. Install perimeter sealant in accordance with Section 07 9200.

M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.

B. Provide field testing of installed storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.

1. Perform a minimum of two tests in each designated area as indicated on drawings.
2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf (200 Pa).
    a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce (14 gram) that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.

C. Repair or replace storefront components that have failed designated field testing, and retest to verify performance conforms to specified requirements.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

C. Remove excess sealant by method acceptable to sealant manufacturer.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 4413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing and glass infill panels.

B. Aluminum Doors and Frames

C. Perimeter sealant.

D. Door Hardware

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel Framing: Steel attachment members.

B. Section 07 1300 - Self-Adhered Sheet Membrane: Perimeter air and vapor seal between glazing systems and adjacent construction.

C. Section 07 2726 - Fluid Applied Non Permable Air Barrier: Perimeter air and vapor seal between glazing systems and adjacent construction.

D. Section 07 8400 - Firestopping: Firestop at system junction with structure.

E. Section 07 9200 - Joint Sealants: Perimeter sealant and back-up materials.

F. Section 08 4313 - Aluminum-Framed Storefronts: Interior entrance framing and doors.

G. Section 08 7100 - Door Hardware: Hardware items other than specified in this section

H. Section 08 8000 - Glazing. Glass and glazing accessories

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.

D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.

E. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

H. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2006 (Reapproved 2011).

I. ASTM C793 - Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants; 2005 (Reapproved 2010).

J. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

K. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2000 (Reapproved 2011).

L. ASTM C1135 - Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants; 2015.

M. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2018, with Editorial Revision.

N. ASTM C1249 - Standard Guide for Secondary Seal for Sealed Insulating Glass Units for Structural Sealant Glazing Applications; 2006 (Reapproved 2010).

O. ASTM C1401 - Standard Guide for Structural Sealant Glazing; 2014.

P. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

Q. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 013300 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, _____, and infill.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

D. Shop Drawings: Provide details of proposed structural sealant glazing (SSG) and weather sealant joints indicating dimensions, materials, bite, thicknesses, profile, and support framing.

E. Samples: Submit two samples 4 by 4 inches (102 by 102 mm) in size illustrating finished aluminum surface, glazing, infill panels, and glazing materials.

F. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.

B. Verify that each component is appropriate for use in structural sealant glazing (SSG) application in regards to at least the following properties; size, shape, dimensions, material, self-life, storage conditions, and color.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See Section 017700 - Closeout Procedures, for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

C. Provide two year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide two year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Kawneer North America; Product Kawneer Aluminum Curtain Wall: 1600 Wall System 1, Clearwall .

B. Glazed Aluminum Curtain Walls:
   1. Oldcastle Building Envelope; _____: www.oldcastlebe.com/#sle.
   2. YKK AP America Inc; YCW 750 OG: www.ykkap.com.
   3. Or approved equal.

2.02 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Outside glazed, with pressure plate and mullion cover, where indicated on drawings.
   2. Vertical Mullion Dimensions: 1600 System 2-1/2 inches by 7-1/2 inches.
   3. Finish: Superior performing organic coatings.
      a. Factory finish surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
      c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   4. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with the applicable code.
      a. Member Deflection: For spans less than 13 feet 6 inches (4115 mm), limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch (19 mm), whichever is less and with full recovery of glazing materials.
      b. Member Deflection: For spans over 13 feet 6 inches (4115 mm) and less than 40 feet (12.2 m), limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch (1/240 of span plus 6.4 mm), with full recovery of glazing materials.
   2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
      a. Expansion and contraction caused by 180 degrees F (82 degrees C) surface temperature.
      b. Expansion and contraction caused by cycling temperature range of 170 degrees F (77 degrees C) over a 12 hour period.
      c. Movement of curtain wall relative to perimeter framing.
      d. Deflection of structural support framing, under permanent and dynamic loads.

C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
   1. Test Pressure Differential: 10 psf (480 Pa).

2. Test Method: ASTM E331.
3. Test Pressure Differential: 12 lbf/sq ft (____ Pa).

D. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft (0.3 L/sec sq m) of wall area, when tested in accordance with ASTM E283 at 6.27 psf (300 Pa) pressure differential across assembly.

E. Air Infiltration Performance Requirements:
1. Limit air infiltration through assembly to 0.06 cu ft/min/sq ft (0.3 L/s/sq m) of wall area or less, measured in accordance with ASTM E283.
2. Air Infiltration Test Pressure Differential: 6.24 pounds per square inch.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.

B. Glazing: As specified in Section 08 8000.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
1. Additional spacers required to be provided and installed by manufacturer:

D. Exterior Doors: Glazed aluminum. Medium Stile Doors with 1" insulated glass.
1. Top Rail: 3 1/2 inches (____ mm) wide.
2. Vertical Stiles: 3 1/2 inches (____ mm) wide.
3. Bottom Rail: 10 inches (254 mm) wide.
4. Glazing Stops: Square.
5. Finish: Same as storefront.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

C. Structural Sealant Glazing (SSG) Adhesive: Neutral curing, silicone sealant formulated for SSG applications in compliance with ASTM C1184 and structural glazing industry guidelines, ASTM C1401.
1. SSG adhesive in compliance with ASTM C920; Type S - Single-component, Grade NS, Class 50, Use NT, G, and A.
2. Ultimate Tensile Strength: Minimum of 50 psi (345 kPa) as determined by test method ASTM C1135 under the following conditions.
a. Exposure to air temperatures of 190 degrees F (88 degrees C) and minus 20 degrees F (minus 29 degrees C).
b. Water immersion for seven (7) days, minimum.
c. Exposure to weathering for 5,000 hours, minimum.
3. Sealant Design Tensile Strength: 20 psi (139 kPa), maximum.
4. Hardness: 20 to 60 with Type A-2 durometer in compliance with test method ASTM C661.
5. SSG sealant tested for compatibility with glazing accessories in compliance with ASTM C1087, tested for accelerated weathering in compliance with ASTM C793, and in compliance with insulating glass secondary sealant design standards of ASTM C1249.

D. Perimeter Sealant: Type as specified in Section [07 9200 Joint Sealants].

E. Glazing: As specified in Section 08 8000.

F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

G. Glazing Accessories: As specified in Section 08 8000.

2.05 FINISHES

A. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent

polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch (0.030 mm).

B. Color: To be selected by Architect from manufacturer's full range.

2.06 HARDWARE

A. For each door, include weatherstripping, sill sweep strip, and threshold.

B. Other Door Hardware: Provide all necessary hardware as needed to provide a complete functional and locking system unless hardware component is otherwise specified in Section 08 7100.

C. Other Door Hardware: Storefront manufacturer's standard type to suit application.
   1. Finish on Hand-Contacted Items: Polished Chrome.
   2. For each door, include butt hinges, pivots, push handle, pull handle, exit device, narrow stile handle latch, and closer.

D. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

E. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.

F. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that curtain wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Coordinate attachment and seal of perimeter air and vapor barrier materials.

H. Install perimeter sealant in accordance with Section [07 9200 Joint Sealants].

I. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

J. Set thresholds in bed of sealant and secure

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft (1.5 mm/m) non-cumulative or 0.5 inches per 100 ft (12 mm/30 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch (19 mm) and minimum of 1/4 inch (6 mm).

3.04 FIELD QUALITY CONTROL

A. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.

B. See Section 01 4000 - Quality Requirements, for general testing and inspection requirements.

C. Water-Spray Test: Provide water spray quality test of installed curtain wall components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as indicated on drawings.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

D. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance conforms to specified requirements.

3.05 ADJUSTING

A. Adjust operating sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.

C. Remove excess sealant by method acceptable to sealant manufacturer.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 5659 - SERVICE WINDOW UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Horizontal sliding interior window units.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

B. Section 08 8000 - Glazing: Glass for service window units.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Submit manufacturer's product data for specified products indicating materials, operation, glazing, finishes, and installation instructions.

C. Shop Drawings: Indicate configuration, sizes, rough-in, mounting, anchors and fasteners, and installation clearances.

D. Test Data: Test reports for specific window model and glazing to be furnished, showing compliance with all specified requirements; window and glazing may be tested separately, provided window test sample adequately simulates the glazing to be used.

E. Manufacturer Qualification Statement.

F. Installer Qualification Statement.

G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least ten years documented experience, and with ability to provide test reports showing that their standard manufactured products meet the specified requirements.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver units in manufacturer's original packaging and unopened containers with identification labels intact.

B. Store units in area protected from exposure to weather and vandalism.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's warranty agreeing to repair or replace units and their components that fail in materials or workmanship within five years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SERVICE AND TELLER WINDOW UNITS

A. Manufacturers :

1. Easi-Serv Products; SS Series: www.easi-serv.com.
2. Ready Access, Inc; 275 Low Profile: www.ready-access.com.
3. Or prior approved equal.

B. Location: Built within interior wall, as indicated on drawings.

C. Type of Use: Walk-up.

D. Window Type: Sliding, single horizontal.
1. Operation: Manual.
2. Mounting: Flush with the wall surface.
3. Window Size: As indicated on drawings.
4. Material: Aluminum.
a. Finish: Natural anodized.

E. Glazing: Glass type GL-4 as specified in Section 08 8000, unless indicated otherwise on Drawings, clear.

2.02 COMPONENTS

A. Windows: Factory-fabricated, finished, and glazed, with extruded aluminum frame and glazing stops; complete with hardware and anchors.
1. Provide window units that are re-glazable from the secure side without dismantling the non-secure side of framing.
2. Rigidly fit and secure joints and corners with internal reinforcement. Make joints and connections flush, hairline, and weatherproof. Fully weld corners.
3. Apply factory finish to all exposed surfaces.
4. Horizontal Sliding Windows: Top-hung operable sash; hook bolt locking device with thumb-turn release.

2.03 MATERIALS

A. Aluminum Extrusions: Minimum 1/8 inch (3.2 mm) thick frame and sash material complying with ASTM B221 and ASTM B221M.
1. Mill Finished Aluminum Surfaces: Manufacturer's standard finish.
2. Finish: Class II natural anodized.

B. Stainless Steel: Type 304 with No. 3 - Coarse finish.

C. Concealed Steel Items: Galvanized in accordance with ASTM A123/A123M to thickness Grade 85, 2.0 ounces per square foot (610 gm/sq m).

D. Ballistic Resistant Glazing: Laminated plastic and glass construction, with glass on both faces; complying with performance level indicated, as specified in Section 08 8000 "Glazing", Type GL-4, unless otherwise indicated on Drawings.

2.04 FINISHES

A. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils (0.01 mm) thick.

2.05 ACCESSORIES

A. Hardware and Security Devices for Sliding Windows:
1. Hook-Lock: Maximum security hook lock on all sliders.
2. Bottom Sills: Stainless steel construction, no bottom tracks and no pop rivets.
3. Handles: Stainless steel, manufacturer's standard profile and finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that window openings are ready for installation of windows.

B. Verify that correct embedded anchors are in place and in proper location; repair or replace anchors as required to achieve satisfactory installation.

C. Notify Architect if conditions are not suitable for installation of units; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install units in correct orientation (inside/outside or secure/non-secure).

C. Anchor units securely in manner so as to achieve performance specified.

D. Remove and replace defective work.

3.03 ADJUSTING

A. Adjust operating components for smooth operation while also maintaining a secure, weather-tight enclosure and a tight fit at the contact points; lubricate operating hardware.

3.04 CLEANING

A. Remove protective material from factory finished surfaces.

B. Clean exposed surfaces promptly after installation without damaging finishes.

3.05 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain operable units.
   1. Instructor: Manufacturer's training personnel.
   2. Location: At project site.
   3. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

3.06 PROTECTION

A. Provide temporary protection to ensure that service and teller windows are without damage upon Date of Substantial Completion.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Automatic operators.
4. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Flush Wood Doors”.
3. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
4. Division 08 Section “All-Glass Entrances”.
5. Division 08 Section “Automatic Door Operators”.
6. Division 28 Section “Access Control Hardware Devices”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.

7. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
8. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary Integrated Wiegand Access Control Products.

E. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

F. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

G. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

A. Hardware Supplier and Hardware Installer must obtain a license with the Louisiana Office of State Fire Marshall in accordance to RS 40:1464 and RS 40:1664.

B. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

C. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

D. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

E. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity..

F. Integrated Wireless, and IP-Enabled Access Control Products Supplier Qualifications: Integrated access control products and accessories are required to be supplied and installed through current members of the ASSA ABLOY "Authorized Channel Partner" (ACP) and "Certified Integrator" (CI) programs. Suppliers are to be factory trained, certified prior to project bid, and a direct purchaser of the specified product. Installers are to be factory trained, certified prior to project bid, and are responsible for commissioning, servicing, and warranting the installed equipment specified for the project.

G. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

H. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

I. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.

4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

J. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

K. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified

hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Please note that ASSA ABLOY is transitioning the Yale Commercial brand to Arrow. This affects only the brand name; the products and product numbers will remain unchanged. The brand transition is expected to be complete in or about May of 2024, and products shipping after that time will be branded Arrow.

D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

   a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

   a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in

hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

a. McKinney (MK) - TA/T4A Series, 5 knuckle.

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:.

a. Pemko (PE).

2.3 FLOOR CLOSERS AND PIVOTS

A. Pivots: ANSI/BHMA A156.4, Grade 1; space intermediate pivots equally not less than 25 inches on center apart or not more than 35 inches on center for doors over 121 inches high. Pivot hinges to have oil impregnated bronze bearing in the top pivot and a radial roller and thrust bearing in the bottom pivot with the bottom pivot designed to carry the full weight of the door. Pivots to be UL listed for windstorm where applicable.

1. Manufacturers:

a. Norton Rixson (RF).

2.4 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

a. McKinney (MK) - QC (# wires) Option.

B. Electrified Quick Connect Continuous Geared Transfer Hinges: Provide electrified transfer continuous geared hinges with a removable service panel cutout accessible without de-mounting door from the frame. Furnish with Molex™ standardized plug connectors with sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to

through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Pemko (PE) - SER-QC (# wires) Option.

C. Electrified Quick Connect Intermediate Transfer Pivots: Provide electrified offset intermediate transfer pivot hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Norton Rixson (RF) - E-M19-QC (# wires).

D. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

    a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
    b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

    a. McKinney (MK) - QC-C Series.

2.5 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.

4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

    a. Rockwood (RO).

B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.

1. Manufacturers:

    a. Rockwood (RO).

C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

6. Manufacturers:

    a. Rockwood (RO).

D. Locking Pull System: Post-mount style door pulls with integrated deadbolt locking system in type and design as specified in the Hardware Sets. Pulls available in multiple head, floor, or combination locking options, with outside keyed rim cylinder operation and inside turn piece activation. Mounting applications for aluminum, glass, steel and wood doors, with customized sizing and configuration options. Locking pulls shall be provided with a 10” clearance from the finished floor on the cylinder side to accommodate wheelchair accessibility.

1. Manufacturers:

    a. Rockwood (RO) - LP Series.

E. Flat Latch Locking Pulls: Post-mount style door pulls with integrated flat latch locking system in type and design as specified in the Hardware Sets. Full and half height with

latching at top of door. Option for horizontal push bar. Mechanical or electric strike release as specified. Dogging and ADA thumbturn included. Customized sizing and configuration options.

1. Manufacturers:

    a. Rockwood (RO) - FL Series.

2.6 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Manufacturer’s Standard.

C. Small Format Interchangeable Cores: Provide small format interchangeable cores (SFIC) as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.

D. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer’s United States patents.

1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.

2. Manufacturers:

    a. Medeco (MC) - X4.

E. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.

3. New System: Key locks to a new key system as directed by the Owner.

F. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).
4. Construction Control Keys (where required): Two (2).
5. Permanent Control Keys (where required): Two (2).

G. Construction Keying: Provide temporary keyed construction cores.

H. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.7 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

a. Lund Equipment (LU).
b. MMF Industries (MM).
c. Telkee (TK).

2.8 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Manufacturers:

a. Sargent Manufacturing (SA) - 8200 Series.

B. Mortise Locksets, Grade 1 (Commercial Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed.

1. Manufacturers:

2.9 STAND ALONE ACCESS CONTROL LOCKING DEVICES

A. Stand Alone Electronic Keypad Locksets: Internal, battery-powered, self-contained ANSI Grade 1 mortise or cylindrical lock consisting of electronically motor driven locking mechanism and integrated keypad without requirements for separate electronic programming devices. Locks to accept standard, interchangeable (removable) core, security and high security override cylinders. Provide keypad locks with a minimum 100 user codes furnished standard with 6 "AA" batteries and non-volatile memory.

1. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

2. Manufacturers:

    a. Sargent Manufacturing (SA) - KP Series.

2.1 INTEGRATED WIRED OUTPUT LOCKING DEVICES – MULTI-CLASS READER

A. Integrated Wired Output Multi-Class Mortise Locks: Wiegand or Open Supervised Device Protocol (OSDP) output ANSI A156.13, Grade 1, mortise lockset with integrated card reader with or without keypad option, request-to-exit signaling, door position status switch, and latchbolt monitoring in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle trim, 3/4" deadlocking anti-friction latch, and 1" case-hardened steel deadbolt. Lock is U.L listed and labeled for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand or OSDP compatible access control systems. Latchbolt monitoring and door position switch act in conjunction to report door-in-frame (DPS) and door latched (door closed and latched) conditions.
2. Integrated reader supports the following credentials:

    a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
    b. 13.56 MHz proximity credentials: HID Secure Identity Object™ (SIO) on iCLASS Seos, HID iCLASS, HID iCLASS SE/SR, MIFARE Classic, DESFire EV1 and EV2.
    c. 2.4 GHz credentials: Secure Identity Object™ (SIO) on Mobile IDs (Bluetooth Smart)
    d. ISO14443A/B (PIV-compatible Transparent FASC-N read) available with pivCLASS variant
    e. NFC-enabled mobile phones
    f. PIN code only or PIN + credential with keypad option.

3. 12VDC external power supply required for reader and lock, with optional 24VDC lock solenoid. Fail safe or fail secure options.

4. Energy Efficient Design: Provide lock bodies which have a holding current draw of 500mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
5. Support end-of-line resistors contained within the lock case.
6. Installation requires only one cable run from the lock to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
7. Installation to include manufacturer's access control panel interface board or module where required for Wiegand or OSDP output protocol.

8. Manufacturers:

    a. Sargent Manufacturing (SA) – SN200/SN210 8200 Series.

2.2 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.3 ELECTROMAGNETIC LOCKING DEVICES

A. Surface Electromagnetic Locks (Heavy Duty): Electromagnetic locks to be surface mounted type conforming to ANSI A156.23, Grade 2 with minimum holding force strength of 1,200 pounds. Locks to be capable of accepting between 12 to 24 volts direct current and be UL listed for use on fire rated door assemblies. Electromagnetic coils are to consume no more than 1.5W during normal operation. Locks are to have an integrated door position switch, tamper switch, and lock bond sensor. Locks are to have integrated motion sensor and/or security camera as indicated in the hardware sets. Locks to be capable of detecting door prop conditions and entering low power mode. Provide mounting accessories as needed to suit opening conditions. Power

supply to be by the same manufacturer as the lock with combined products having a lifetime replacement warranty.

1. Manufacturers:

    a. Securitron (SU) - M680E Series.

2.4 ELECTRIC STRIKES

A. Standard Electric Strikes: Electric strikes conforming to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 1 million operating cycles. Provide strikes with 12 or 24 VDC capability, fail-secure unless otherwise specified. Where specified provide latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.

1. Manufacturers:

    a. HES (HS) - 1500/1600 Series.

B. Surface Mounted Rim Electric Strikes: Surface mounted rim exit device electric strikes conforming to ANSI/BHMA A156.31, Grade 1, and UL Listed for both Burglary Resistance and for use on fire rated door assemblies. Construction includes internally mounted solenoid with two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Strikes tested for a minimum of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike. Strike requires no cutting to the jamb prior to installation.

1. Manufacturers:

    a. HES (HS) - 9400/9500/9600/9700/9800 Series.

C. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

2.5 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.

2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper

fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.

9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

10. Rail Sizing: Provide exit device rails factory sized for proper door width application.

11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

    a. Sargent Manufacturing (SA) - 80 Series.

2.6 ELECTROMECHANICAL EXIT DEVICES

A. Electromechanical Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices subject to same compliance standards and requirements as mechanical exit devices. Electrified exit devices to be of type and design as specified below and in the hardware sets.

1. Energy Efficient Design: Provide devices which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

2. Where conventional power supplies are not sufficient, include any specific controllers required to provide the proper inrush current.

3. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.

4. Manufacturers:

    a. Sargent Manufacturing (SA) - 80 Series.

2.7 INTEGRATED WIRED OUTPUT EXIT DEVICES - MULTI-CLASS READER

A. Integrated Wired Output Multi-Class Exit Hardware: Wiegand output ANSI 156.3 Grade 1 rim, mortise, and vertical rod exit device hardware with integrated card reader with or without keypad option, latchbolt and touchbar monitoring, and request-to-exit signaling, in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle exit trim with 3/4" throw latch bolt. U.L listed and labeled for either panic or "fire exit hardware" for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand or OSDP compatible access control systems. Inside push bar (request-to-exit) signaling and door position (open/closed status) monitoring (via separately connected DPS).
2. Integrated reader supports the following credentials:

    a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
    b. 13.56 MHz proximity credentials: HID Secure Identity Object™ (SIO) on iCLASS Seos, HID iCLASS, HID iCLASS SE/SR, MIFARE Classic, DESFire EV1 and EV2.
    c. 2.4 GHz credentials: Secure Identity Object™ (SIO) on Mobile IDs (Bluetooth Smart)
    d. ISO14443A/B (PIV-compatible Transparent FASC-N read) available with pivCLASS variant
    e. NFC-enabled mobile phones

f. PIN code only or PIN + credential with keypad option

3. 12VDC external power supply required for reader. 24VDC required for solenoid operated exit trim. Fail safe or fail secure options.
4. Installation requires only one cable run from the exit hardware to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
5. Competitor Alternates Allowed Option: Installation to include manufacturer's access control panel interface board or module where required for Wiegand or OSDP output protocol.

6. Manufacturers:

a. Sargent Manufacturing (SA) – SN200/SN210 80 Series.

2.8 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable

backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Heavy duty surface mounted door closers shall have a 30-year warranty.

2. Manufacturers:

    a. Sargent Manufacturing (SA) - 351 Series.

2.9 ELECTROHYDRAULIC DOOR OPERATORS

A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.

1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

B. Standard: Conforming to ANSI/BHMA A156.19.

C. Performance Requirements:

1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.

D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.

E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.

F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.

G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.

H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.

I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Norton Rixson (NO) - 6000 Series.

2.10 SURFACE MOUNTED CLOSER HOLDERS

A. Electromagnetic Door Holders: ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate.12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.

1. Manufacturers:

a. Norton Rixson (RF) - 980/990 Series.

2.11 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

6. Manufacturers:

a. Rockwood (RO).

2.12 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Rockwood (RO).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. Norton Rixson (RF).
b. Rockwood (RO).
c. Sargent Manufacturing (SA).

2.13 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. Pemko (PE).

2.14 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

a. Securitron (SU) - DPS Series.

B. Switching Power Supplies: Provide power supplies with either single or dual voltage configurations at 12 or 24VDC. Power supplies shall have battery backup function with an integrated battery charging circuit and shall provide capability for power distribution, direct lock control and Fire Alarm Interface (FAI) through add on modules. Power supplies shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs.

1. Manufacturers:

a. Securitron (SU) - AQD Series.

2.15 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.16 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer’s Abbreviations:

1. GS - ASSA ABLOY Glass Solutions
2. MK - McKinney
3. PE - Pemko
4. RF - Rixson
5. RO - Rockwood
6. SA - SARGENT
7. SU - Securitron

8. RS - RITE Slide
9. MC - Medeco
10. HS - HES
11. NO - Norton
12. OT - Other

Hardware Sets based on plans dated 6/29/2023 – 100% Pricing Set
At aluminum frames, gasketing / silencer is by frame manufacturer.

Set: 1.0
Doors: CL1000
Description: Pr - ASF Exterior - EO Delayed Egress Exit - Closer

2 Electrified Inter Pivot	EML19 QC*	613E	RF	
2 Pivot Set	147	613E	RF	
2 Intermediate Pivot	M19	613E	RF	
2 CVR, Exit Only, Delayed Egress	59 ADPE8410 EO	US10BE	SA	
2 Closer	351 CPS	EB	SA	
2 Drop Plate	351D	EB	SA	
2 Kit	581-2	EB	SA	
1 Panic Threshold	2005DT MSES25SS x Opening Width			PE
1 Rain Guard	346D		PE	
1 Perimeter Seals	By the frame manufacturer		OT	
2 Sweep	18061DNB x Dr. Width		PE	
2 Door Wire Harness	QC-C*** (length / type as required)			MK
2 Position Switch	DPS-M/W-BK (as req'd per app)		SU	
1 Power Supply	AQD Series		SU	
1 Card Reader	By Security Contractor.		OT	

Notes: Doors are normally closed and secure. Unauthorized exit attempt will initiate immediate alarm and 15-second delay to exit. Valid credential will bypass alarm for immedate exit. Upon loss of power or signal from fire control, doors will allow free and immediate egress.

Set: 2.0
Doors: MS3019a
Description: Sgl - ASF Exterior - NL - Delayed Egress Exit - Electric Strike - AO

1 Electrified Inter Pivot	EML19 QC*	613E	RF	
1 Pivot Set	147	613E	RF	
1 Intermediate Pivot	M19	613E	RF	
1 Rim Exit NL Delayed Egress	59 72 PE8504 862	US10BE	SA	
1 Small Format Inter Core	Medeco X4		MC	
1 SMART Pac Bridge Rectifier	2005M3		HS	
1 Electric Strike	9400	613E	HS	
1 Automatic Opener	6000 Series	690	NO	
1 Panic Threshold	2005DT MSES25SS x Opening Width			PE
1 Rain Guard	346D		PE	

1	Perimeter Seals	By the frame manufacturer	OT	
1	Sweep	18061DNB x Dr. Width	PE	
2	Frame Wire Harness	QC-C1500P	MK	
1	Door Wire Harness	QC-C*** (length / type as required)		MK
1	Position Switch	DPS-M/W-BK (as req'd per app)	SU	
1	Door Switch	501	NO	
1	Power Supply	AQD Series	SU	
2	Card Reader	By Security Contractor.	OT	

Notes: Doors are normally closed and secure. Unauthorized exit attempt will initiate immediate alarm and 15-second delay to exit. Valid credential will bypass alarm for immedate exit. Upon loss of power or signal from fire control, doors will allow free and immediate egress. Push button at interior or valid credential at exterior will release electric strike, retract latches and initiate auto operator sequence.

Set: 3.0
Doors: CL1003, CL1004, CL1005, CL1006, CL1007, CL1009, CL1020, CL1021, CL1022, CL1023, CL1031, HA2008, HA2010, HA2012, MS3013, MS3017
Description: Single - All Glass - Locking Deadbolt Pull - OHC Closer

1	Door Rail/Patch	By Glass Door Supplier		GS
1	Cylinder	72 Type as required	US10BE	SA
1	Small Format Inter Core	Medeco X4		MC
1	Locking Pull	By Glass Door Supplier	10BE	GS
1	Concealed Closer	By Glass Door Supplier		GS
1	Door Stop	RM851	10BE	RO

Set: 4.0
Doors: CL1000a, CL1000b
Description: Single - All Glass - Locking Deadbolt Pull - Electric Strike- OHC Closer

1	Door Rail/Patch	By Glass Door Supplier		GS
1	Bottom Pivot	PV-ENDLOAD		GS
1	Cylinder	72 Type as required	US10BE	SA
1	Small Format Inter Core	Medeco X4		MC
1	Electric Strike Kit	By Glass Door Supplier	10BE	GS
1	Locking Pull	By Glass Door Supplier	10BE	GS
1	Concealed Closer	By Glass Door Supplier		GS
1	Door Stop	RM851	10BE	RO
1	Power Supply	AQD Series		SU
1	Card Reader	By Security Contractor.		OT

Set: 5.0
Doors: FS6002d, PP4028
Description: Single - Exterior - SN200 Exit - Closer - Access Control - Inswing

3	Hinge, Full Mortise, Hvy Wt	T4A3386 NRP	US10BE(SS)	MK
1	Hinge, Full Mortise, Hvy Wt	T4A3386 QC*	US10BE	MK

1	Access Control Mort Lock	72 SN200-82271 BIS-0E LNREM	US10BE	SA
1	Rim Exit Device	TB 72 56-SN200-PE8804 PSB	US10BE	SA
1	Small Format Inter Core	Medeco X4		MC
1	Closer	351 CPS	EB	SA
1	Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1	Panic Threshold	2005DT MSES25SS x Opening Width		PE
1	Gasketing	2891DS (head & jambs)		PE
1	Rain Guard	346D x Frame Width		PE
1	Sweep	345DNB x Dr. Width		PE
1	Frame Wire Harness	QC-C1500P		MK
2	Door Wire Harness	QC-C*** (length / type as required)		MK
1	Power Supply	AQD Series		SU

Notes: Operation: Door normally closed and locked with fail secure electric lock. Valid card at the card reader unlocks the outside lever for entry. Free egress at all times. Door status monitored.

Set: 6.0
Doors: CL1010b
Description: Single - Exterior - EO Exit - Closer

4	Hinge, Full Mortise, Hvy Wt	T4A3386 NRP	US10BE(SS)	MK
1	Rim Exit Device, Exit Only	TB PE8810 EO	US10BE	SA
1	Closer	351 CPS	EB	SA
1	Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1	Panic Threshold	2005DT MSES25SS x Opening Width		PE
1	Rain Guard	346D		PE
1	Gasketing	2891DS (head & jambs)		PE
1	Sweep	345DNB x Dr. Width		PE

Notes: The specified hardware is for design intent only for hurricane/windstorm. Verify and supply all products in compliance with the door manufacturers assembly rating for hurricane/windstorm.

Set: 7.0
Doors: SG5024d
Description: Single - Exterior - EO Delayed Egress Exit - Closer

3	Hinge, Full Mortise, Hvy Wt	T4A3386 NRP	US10BE(SS)	MK
1	Hinge, Full Mortise, Hvy Wt	T4A3386 QC*	US10BE	MK
1	Rim Exit Device, Exit Only, Delayed US10BE	TB 59 PE8810 EO	SA	
1	Closer	351 CPS	EB	SA
1	Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1	Panic Threshold	2005DT MSES25SS x Opening Width		PE
1	Rain Guard	346D		PE
1	Gasketing	2891DS (head & jambs)		PE

1 Sweep	345DNB x Dr. Width		PE	
1 Door Wire Harness	QC-C*** (length / type as required)			MK
1 Position Switch	DPS-M/W-BK (as req'd per app)		SU	
1 Power Supply	AQD Series		SU	
1 Card Reader	By Security Contractor.		OT	

Notes: Doors are normally closed and secure. Unauthorized exit attempt will initiate immediate alarm and 15-second delay to exit. Valid credential will bypass alarm for immedate exit. Upon loss of power or signal from fire control, doors will allow free and immediate egress.

Set: 8.0
Doors: FS6002c
Description: Pr - Exterior - EO Delayed Egress Exit - Closer

6 Hinge, Full Mortise, Hvy Wt	T4A3386 NRP	US10BE(SS)		MK
2 Hinge, Full Mortise, Hvy Wt	T4A3386 QC*	US10BE	MK	
2 CVR, Exit Only, Delayed Egress	TB 59 MDPE8610 EO	US10BE	SA	
2 Closer	351 CPS	EB	SA	
2 Kick Plate	K1050 12" 4BE CSK	US10BE	RO	
1 Panic Threshold	2005DT MSES25SS x Opening Width			PE
1 Rain Guard	346D		PE	
1 Gasketing	2891DS (head & jambs)		PE	
2 Sweep	345DNB x Dr. Width		PE	
1 Astragal Set (2)	303DS		PE	
2 Door Wire Harness	QC-C*** (length / type as required)			MK
2 Position Switch	DPS-M/W-BK (as req'd per app)		SU	
1 Power Supply	AQD Series		SU	
1 Card Reader	By Security Contractor.		OT	

Notes: Doors are normally closed and secure. Unauthorized exit attempt will initiate immediate alarm and 15-second delay to exit. Valid credential will bypass alarm for immedate exit. Upon loss of power or signal from fire control, doors will allow free and immediate egress.

Set: 9.0
Doors: FS6019b
Description: Single - Exterior - NL Exit - Closer

4 Hinge, Full Mortise, Hvy Wt	T4A3386 NRP	US10BE(SS)		MK
1 Rim Exit Device, NL	TB 72 PE8804 PSB	US10BE	SA	
1 Small Format Inter Core	Medeco X4		MC	
1 Closer	351 CPS	EB	SA	
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO	
1 Panic Threshold	2005DT MSES25SS x Opening Width			PE
1 Rain Guard	346D		PE	
1 Gasketing	2891DS (head & jambs)		PE	
1 Sweep	345DNB x Dr. Width		PE	

Set: 10.0

Doors: FS6011b, FS6017b
Description: Single - Exterior - SN200 Lock - Closer - Access Control

3 Hinge, Full Mortise, Hvy Wt	T4A3386 NRP	US10BE(SS)		MK
1 Hinge, Full Mortise, Hvy Wt	T4A3386 QC*	US10BE	MK	
1 Access Control Mort Lock	72 SN200-82271 BIS-0E LNREM	US10BE	SA	
1 Small Format Inter Core	Medeco X4		MC	
1 Closer	351 CPS	EB	SA	
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO	
1 Panic Threshold	2005DT MSES25SS x Opening Width			PE
1 Gasketing	2891DS (head & jambs)		PE	
1 Rain Guard	346D x Frame Width		PE	
1 Sweep	345DNB x Dr. Width		PE	
1 Frame Wire Harness	QC-C1500P		MK	
1 Door Wire Harness	QC-C*** (length / type as required)			MK
1 Power Supply	AQD Series		SU	

Notes: Operation: Door normally closed and locked with fail secure electric lock. Valid card at the card reader unlocks the outside lever for entry. Free egress at all times. Door status monitored.

Set: 11.0
Doors: MS3021
Description: Single - Exterior - SN200 Lock - Closer - Access Control - Inswing

3 Hinge, Full Mortise, Hvy Wt	T4A3386 NRP	US10BE(SS)		MK
1 Hinge, Full Mortise, Hvy Wt	T4A3386 QC*	US10BE	MK	
1 Access Control Mort Lock	72 SN200-82271 BIS-0E LNREM	US10BE	SA	
1 Small Format Inter Core	Medeco X4		MC	
1 Door Closer	351 O / P9 (type as req'd)	EB	SA	
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO	
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO	
1 Saddle Threshold	171D MSES25SS x Opening Width			PE
1 Gasketing	2891DS (head & jambs)		PE	
1 Rain Guard	346D x Frame Width		PE	
1 Sweep	345DNB x Dr. Width		PE	
1 Frame Wire Harness	QC-C1500P		MK	
1 Door Wire Harness	QC-C*** (length / type as required)			MK
1 Power Supply	AQD Series		SU	

Notes: Operation: Door normally closed and locked with fail secure electric lock. Valid card at the card reader unlocks the outside lever for entry. Free egress at all times. Door status monitored.

Set: 12.0
Doors: CL1002, SG5000
Description: Rite Slide - Office

1	Entry Lock	S9650 205 - Custom color	US10BE	RS
1	Balance of hardware	By the door manufacturer		RS

Set: 13.0
Doors: SG5027
Description: Pair - Wide - ELR Exit Device-SRL/DT - Auto Operator - Access Control

2	Continuous Hinge - Swing Clear	_OS__FM-HD1 SER		PE
1	SVR NL MELR RX	TB 55 56 72 NBPE8706 WEREM	US10BE	SA
1	SVR DT MELR RX	TB 55 56 NBPE8710 WEREM	US10BE	SA
1	Small Format Inter Core	Medeco X4		MC
2	Automatic Opener	6000 Series	690	NO
2	Kick Plate	K1050 12" 4BE CSK	US10BE	RO
2	Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1	Gasketing	S88BL (head & jambs)		PE
2	Astragal	18061DNB x Dr. Ht.		PE
2	Frame Wire Harness	QC-C1500P		MK
2	Door Wire Harness	QC-C*** (length / type as required)		MK
2	Position Switch	DPS-M/W-BK (as req'd per app)		SU
1	Door Switch	501		NO
1	Power Supply	AQD Series		SU
1	Card Reader	By Security Contractor.		OT

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latches on both leafs and cycles the automatic operator. Free egress at all times by depressing the exit device rail or depressing the inside actuator retracts the latches on the exit devices and cycles the automatic operator. Door status monitored.

Set: 14.0
Doors: HA2002b, SG5024a, SG5024b, SG5024c
Description: Dbl Egress - Exit Device-EO/EO - Auto Operator - Mag Locks - (1)Access Control

2	Continuous Hinge - Swing Clear	_OS__FM-HD1 SER		PE
1	Magnetic Lock	M680BD	613E	SU
2	SVR EO MELR RX	55 56 NBPE8710 EO	US10BE	SA
2	Automatic Opener	6000 Series	690	NO
2	Kick Plate	K1050 12" 4BE CSK	US10BE	RO
2	Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1	Gasketing	S88BL (head & jambs)		PE
1	Astragal Set (2)	S772BL		PE
2	Frame Wire Harness	QC-C1500P		MK
2	Door Wire Harness	QC-C*** (length / type as required)		MK
2	Position Switch	DPS-M/W-BK (as req'd per app)		SU

1	Door Switch	501		NO
1	Power Supply	AQD Series		SU
1	Card Reader	By Security Contractor.		OT

Notes: Operation: Doors normally closed and locked with electromagnetic lock. Valid card at the card reader on the locked side or actuator on the unlocked side of the opening releases the electromagnetic lock, retracts the latches and cycles the automatic operators. Free egress from the unlocked side. Must be tied to an approved fire alarm system. Activation of the fire alarm or signal from fire command shunts power to the electromagnetic locks for immediate egress. Door status monitored.

Set: 15.0
Doors: FS6002a, MS3019b
Description: Dbl Egress - Fire Rated Exit Device-EO/EO - Auto Operator - Mag Locks - (1)Access Control

2	Continuous Hinge - Swing Clear	_OS__FM-HD1 SER		PE	
1	Magnetic Lock	M680BD	613E	SU	
2	SVR EO MELR RX Rated	12 55 56 NBPE8710 EO	US10BE	SA	
2	Automatic Opener	6000 Series	690	NO	
2	Kick Plate	K1050 12" 4BE CSK	US10BE	RO	
2	Door Stop	406 / 441H (as req'd per app)	US10BE	RO	
1	Gasketing	S88BL (head & jambs)		PE	
1	Astragal Set (2)	S772BL		PE	
2	Frame Wire Harness	QC-C1500P		MK	
2	Door Wire Harness	QC-C*** (length / type as required)			MK
2	Position Switch	DPS-M/W-BK (as req'd per app)		SU	
1	Door Switch	501		NO	
1	Power Supply	AQD Series		SU	
1	Card Reader	By Security Contractor.		OT	

Notes: Operation: Doors normally closed and locked with electromagnetic lock. Valid card at the card reader on the locked side or actuator on the unlocked side of the opening releases the electromagnetic lock, retracts the latches and cycles the automatic operators. Free egress from the unlocked side. Must be tied to an approved fire alarm system. Activation of the fire alarm or signal from fire command shunts power to the electromagnetic locks for immediate egress. Door status monitored.

Set: 16.0
Doors: MS3040
Description: Dbl Egress - Exit Device-EO/EO - Closer w/HD-PA - Mag Hold Open

2	Continuous Hinge - Swing Clear	_OS__FM-HD1		PE
2	SVR, Exit Only	NBPE8710 EO	US10BE	SA
2	Closer	351 P10	EB	SA
2	Kick Plate	K1050 12" 4BE CSK	US10BE	RO

2 Electromagnetic Holder	998M	690	RF	
1 Gasketing	S88BL (head & jambs)		PE	
2 Astragal	18061DNB		PE	

Notes: Operation: Doors held open with electromagnetic hold open device. Must be tied to an approved fire alarm system. Activation of the fire alarm or signal from fire command releases the electromagnetic hold opens and the doors close and latch.

Set: 17.0
Doors: CL1050, HA2011b, MS3015, PP4040a, PP4040b, SG5001a, SG5001b, SG5023
Description: Single - SN200 Lock - Closer - Gasket

3 Hinge, Full Mortise	TA2714	US10BE	MK	
1 Hinge, Full Mortise	TA2714 QC*	US10BE	MK	
1 Access Control Mort Lock	72 SN200-82271 BIS-0E LNREM	US10BE	SA	
1 Small Format Inter Core	Medeco X4		MC	
1 Door Closer	351 O / P9 (type as req'd)	EB	SA	
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO	
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO	
1 Gasketing	S88BL (head & jambs)		PE	
1 Frame Wire Harness	QC-C1500P		MK	
1 Door Wire Harness	QC-C*** (length / type as required)			MK
1 Power Supply	AQD Series		SU	

Notes: Operation: Door normally closed and locked with fail secure electric lock. Valid card at the card reader unlocks the outside lever for entry. Free egress at all times. Door status monitored.

Set: 18.0
Doors: CL1010a, FS6002b, MS3007
Description: Single - SN200 Lock - Closer - Gasket - Wide

3 Hinge, Full Mortise, Hvy Wt	T4A3786	US10BE	MK	
1 Hinge (heavy weight)	T4A3786 QC*	US10BE	MK	
1 Access Control Mort Lock	72 SN200-82271 BIS-0E LNREM	US10BE	SA	
1 Small Format Inter Core	Medeco X4		MC	
1 Door Closer	351 O / P9 (type as req'd)	EB	SA	
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO	
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO	
1 Gasketing	S88BL (head & jambs)		PE	
1 Frame Wire Harness	QC-C1500P		MK	
1 Door Wire Harness	QC-C*** (length / type as required)			MK
1 Power Supply	AQD Series		SU	

Notes: Operation: Door normally closed and locked with fail secure electric lock. Valid card at the card reader unlocks the outside lever for entry. Free egress at all times. Door status monitored.

Set: 19.0
Doors: CL1001a, CL1017a, CL1043, CL1045, FS6007, FS6011a, HA2011a, MS3012, MS3016, PP4001, PP4034, PP4035, SG5007, SG5015b, SG5021, SG5022, SG5025, SG5028
Description: Single - Keypad Lock - Closer - Gasket

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Keypad Mortise Lock	72 KP8278 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Notes: Operation: Door normally closed and locked with standalone keypad lock. Valid keypad entry unlocks the outside lever for entry. Free egress at all times.

Set: 20.0
Doors: CL1001b, CL1041a, CL1041b, CL1044a, CL1044b, FS6006a, FS6009, FS6012, FS6016, FS6017a, MS3004, SG5006, SG5010a, SG5010b, SG5011a, SG5011b, SG5015a
Description: Single - Keypad Lock - Closer - Gasket - Wide

4 Hinge, Full Mortise, Hvy Wt	T4A3786	US10BE	MK
1 Keypad Mortise Lock	72 KP8278 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Notes: Operation: Door normally closed and locked with standalone keypad lock. Valid keypad entry unlocks the outside lever for entry. Free egress at all times.

Set: 21.0
Doors: HA2006
Description: Single - Storeroom Lock

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Storeroom/Closet Lock	72 8204 LNREM	US10BE	SA

1 Small Format Inter Core	Medeco X4		MC
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
3 Silencer	608		RO

Set: 22.0
Doors: CL1019, FS6003, FS6004, FS6005, FS6019a
Description: Single - Wide - Storeroom Lock - Closer - Gasket

4 Hinge, Full Mortise, Hvy Wt	T4A3786	US10BE	MK
1 Storeroom/Closet Lock	72 8204 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Set: 23.0
Doors: SG5008, SG5009
Description: Single - Wide - Storeroom Lock - Closer/DA - Gasket

4 Hinge, Full Mortise, Hvy Wt	T4A3786	US10BE	MK
1 Storeroom/Closet Lock	72 8204 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Surface Closer	DA 351 O	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Set: 24.0
Doors: SG5013b, SG5014b, SG5016b, SG5017b
Description: Single - Classroom Lock - Closer - Gasket

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Classroom Lock	72 8237 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Set: 25.0
Doors: CL1030, FS6001, MS3018, PP4039
Description: Single - Storeroom Lock - Closer - Gasket

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Storeroom/Closet Lock	72 8204 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Door Closer	351 O / P9 (type as req'd)	EB	SA

1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Set: 26.0
Doors: CL1091
Description: Pair - Storeroom Lock - AFB - Closer/stop

8 Hinge, Full Mortise	TA2714	US10BE	MK
1 Dust Proof Strike	570	10BE	RO
1 Auto Flush Bolt Set	2842 / 2942 (as required)	US10BE	RO
1 Storeroom/Closet Lock	72 8204 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Coordinator	2600 Series x Wear Plates (size to opening)		Black RO
2 Door Closer	351 PS	EB	SA
2 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE
1 Astragal	375DR x Dr. Ht.		PE

Set: 27.0
Doors: FS6018a
Description: Pair - Fire Rated - Storeroom Lock - Closer

8 Hinge, Full Mortise, Hvy Wt	T4A3786	US10BE	MK
1 Dust Proof Strike	570	10BE	RO
1 Auto Flush Bolt Set	2842 / 2942 (as required)	US10BE	RO
1 Storeroom/Closet Lock	72 8204 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Coordinator	2600 Series x Wear Plates (size to opening)		Black RO
2 Mounting Bracket	2601 (size to opening)	Black	RO
2 Door Closer	351 O / P9 (type as req'd)	EB	SA
2 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
2 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE
1 Astragal	375DR x Dr. Ht.		PE

Set: 28.0
Doors: CL1025, CL1027, CL1028, CL1088, FS6010, HA2007a, HA2008b, HA2010b
Description: Single - Office Lock

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Office/Entry Lock	72 8205 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
3 Silencer	608		RO

Set: 29.0

Doors: FS6000, MS3003, MS3010, PP4000
Description: Single - Office Lock - Closer - Gasket

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Office/Entry Lock	72 8205 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Set: 30.0
Doors: CL1018
Description: Single - Classroom Lock - Closer

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Classroom Lock	72 8237 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
3 Silencer	608		RO

Set: 31.0
Doors: SG5002a, SG5003a
Description: Single - Classroom Lock - Closer w/Stop - Gasket

4 Hinge, Full Mortise, Hvy Wt	T4A3786	US10BE	MK
1 Classroom Lock	72 8237 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Door Closer	351 PS	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Set: 32.0
Doors: FS6006b, FS6006c, FS6014, MS3005
Description: Single - Classroom Lock - Closer - Gasket

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Classroom Lock	72 8237 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Set: 33.0
Doors: MS3020a

Description: Single - Wide - Classroom Lock - Closer - Gasket

4 Hinge, Full Mortise, Hvy Wt	T4A3786	US10BE	MK
1 Classroom Lock	72 8237 LNREM	US10BE	SA
1 Small Format Inter Core	Medeco X4		MC
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Set: 34.0
Doors: CL1024, CL1032, CL1033, CL1035, CL1040, FS6015, FS6020, FS6021, HA2004, HA2005, MS3008, MS3009, PP4003, PP4011, PP4019, PP4038, SG5019
Description: Single - Privacy w/Ind - Closer

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Privacy Lock	V50 8265 LNREM	US10BE	SA
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Set: 35.0
Doors: MS3001, MS3023, MS3025, MS3027, MS3029, MS3031, MS3033, MS3035, MS3037, MS3039
Description: Single - Privacy Lock - COHS - PT. TLT

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Privacy Lock	8265 LNREM	US10BE	SA
1 Conc Overhead Stop	1-x36	613E	RF
3 Silencer	608		RO

Set: 36.0
Doors: CL1037, CL1038, CL1039, CL1046, CL1047, CL1048, CL1049
Description: Single - Passage

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Passage Latch	8215 LNREM	US10BE	SA
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
3 Silencer	608		RO

Set: 37.0
Doors: CL1017b
Description: Single - Passage - Closer

4 Hinge, Full Mortise	TA2714	US10BE	MK

1 Passage Latch	8215 LNREM	US10BE	SA
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
3 Silencer	608		RO

Set: 38.0
Doors: CL1029
Description: Single - Wide - Passage

4 Hinge, Full Mortise, Hvy Wt	T4A3786	US10BE	MK
1 Passage Latch	8215 LNREM	US10BE	SA
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
3 Silencer	608		RO

Set: 39.0
Doors: PP4002
Description: Single - Passage - Closer - Gasket

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Passage Latch	8215 LNREM	US10BE	SA
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Set: 40.0
Doors: SG5018, SG5020
Description: Single - Passsage - Electric Strike - Auto Operator

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Passage Latch	7815 PT	US10BE	SA
1 Electric Strike	1500 / 1600	613E	HS
1 SMART Pac Bridge Rectifier	2005M3		HS
1 Automatic Opener	6000 Series	690	NO
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE
1 Frame Wire Harness	QC-C1500P		MK
2 Wall Switch - Wave to Open	700		NO
1 Power Supply	AQD Series		SU

Notes: Operation: Door normally closed and latched. Wave to open actuator on either side of the opening releases the electric strike and cycles the automatic operator.

Set: 41.0
Doors: MS3000, MS3022, MS3024, MS3026, MS3028, MS3030, MS3034, MS3036, MS3038
Description: Single - Wide - Hospital Latch - Passage - Gasket

4 Hinge, Full Mortise, Hvy Wt	T4A3786	US10BE	MK
1 Passage Latch	7815 PT	US10BE	SA
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Set: 42.0
Doors: CL1014, CL1016
Description: Single - Wide - Hospital Latch - Passage - Closer - Gasket

4 Hinge, Full Mortise, Hvy Wt	T4A3786	US10BE	MK
1 Passage Latch	7815 PT	US10BE	SA
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

Set: 43.0
Doors: CL1008, CL1015
Description: Single - Storeroom - Electric Strike - Auto Operator - Access Control

4 Hinge, Full Mortise, Hvy Wt	T4A3786	US10BE	MK
1 Storeroom/Closet Lock	72 8204 LNREM	US10BE	SA
1 Electric Strike	1500 / 1600	613E	HS
1 SMART Pac Bridge Rectifier	2005M3		HS
1 Automatic Opener	6000 Series	690	NO
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE
1 Frame Wire Harness	QC-C1500P		MK
1 Door Switch	501		NO
1 Power Supply	AQD Series		SU
1 Card Reader	By Security Contractor.		OT

Notes: Operation: Doors normally closed and locked. Depressing the actuator on the unlocked side or valid credential at the locked side of the opening releases the electric strike and cycles the automatic operator on the active leaf. Free egress at all times by turning the lever or depressing the inside actuator releases the electric strike and cycles the automatic operator.

Set: 44.0
Doors: MS3032
Description: Unequal Pair - Hospital Latch - Passage

8 Hinge, Full Mortise, Hvy Wt	T4A3786	US10BE	MK
1 Flush Bolt	2805	US10BE	RO
1 Passage Latch	7815 PT	US10BE	SA
2 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
1 Gasketing	S88BL (head & jambs)		PE

1 Astragal Set (2)	S772BL		PE

Set: 45.0
Doors: MS3020b, SG5002b, SG5003b
Description: Single - Push/Pull - Closer

4 Hinge, Full Mortise	TA2714	US10BE	MK
1 Push Plate	70E	10BE	RO
1 Pull Plate	111x70C	10BE	RO
1 Door Closer	351 O / P9 (type as req'd)	EB	SA
1 Kick Plate	K1050 12" 4BE CSK	US10BE	RO
1 Door Stop	406 / 441H (as req'd per app)	US10BE	RO
3 Silencer	608		RO

Set: 46.0
Doors: HA2000, HA2002, PP4004, PP4005, PP4020, PP4021, PP4022, PP4023, PP4024, PP4025, PP4032, PP4033, PP4036, PP4037, SG5013a, SG5014a, SG5016a, SG5017a, X4062, X4063
Description: Sliding doors

1 All Hardware	By the door manufacturer	OT

Set: 47.0
Doors: CL1078, CL1082, CL1084, CL1085, CL1089, CL1090
Description: Sliding Transaction

1 All Hardware	By the door manufacturer	OT

Set: 48.0
Doors: FS6011c, FS6018b
Description: OH Coiling Door

1 All Hardware	By the door manufacturer	OT

END OF SECTION

SECTION 08 8000 - GLAZING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Doors
   2. Storefront framing
   3. Curtainwall framing
   4. Glazed entrances

B. Glazing compounds and accessories.

C. Related Sections
   1. Section 06 4100 - Architectural Wood Casework: Cabinets with requirements for glass components and glass shelving.
   2. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.
   3. Section 08 4313 - Aluminum-Framed Entrances and Storefronts:
   4. Section 08 4413 - Glazed Aluminum Curtain Walls:
   5. Section 08 8300 - Mirrors.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.

C. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.

D. ASTM C1036 - Standard Specification for Flat Glass; 2011.

E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

F. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.

G. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2012a.

H. GANA (LGRM) - Laminated Glazing Reference Manual; 2009.

I. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (2004).

1.04 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating glass unit.

D. Deterioration of Coated Glass: Defects developed from normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Laminated Glass: Defects developed from normal use that is attributed to the manufacturing process and not causes other than glass breakage and practicies for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include

edge separation, delamination, materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated glass standard.

F. Laminated Glass Unit Surface Designations:
   1. Surface 1 - Exterior surface of the outer glass lite.
   2. Surface 2: Interior surface of the outer glass lite.
   3. Surface 3: Exterior surface of the inner glass lite.
   4. Surface 4: Interior surface of the inner glass lite.

1.05 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
   1. Glass Design: Glass thickness designations indicted are minimum and are for detailing only. Confirm glass thicknes by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than the thicknesses and strengths (annealed or heat treated) required to meet of excee the following criteria.
   2. Design Wind Loads: Determine design wind loads applicable to the Project according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures" Section 6.5, "Method 2 - Analytical Procedure" based on mean roof heights above grade indicated on Drawings.

B. Structural Performance and Delegated Design: Engage a qualified engineer to design glazing, including comprehensive engineering analysis, to withstand the following design loads within the limits and under conditions indicated determined according to the IBC and ASTM E 1300:
   1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
      a. Wind Design Data: As indicated on the Structural Drawings.
   2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
   3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
   4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
   5. Seismic Importance Factor: 1.25
   6. Risk Category: III
   7. Basic Nominal Wind Speed: 134 miles per hour
   8. Exposure: B
   9. Internal Pressure Coefficient: +/- 0.18.
   10. Refer to Structural Drawings for Additional Load Design Criteria.
   11. Deflection Limits: For glass supported on all four edges, limit center of glass deflection at design wind presure to not more than 1/50 times the short side length of 1 inch, whichever is less.

C. Glass Thickness: Select minimum glass thicknesses to comply with ASTM E1300, according to the following requirements:
   1. Specified Design Wind Loads: As indicated on the Structural Drawings, but not less than the wind loads applicable to the Project as required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures" Section 6.0 "Wind Loads".
   2. Probability for Breakage for Vertical Glazing: 8 lites per 100 lites set vertically or not more than 15 degrees off vertical and under wind action.
   3. Minimum Glass Thickness for Exterior Lites: Not less than 6.0mm.
   4. Thickness for Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated in the Project.

5. Windbourne Debris Impact Resistance Test Performance: Provide glazing for aluminum framed systems that pass large and small missile impact tests and cyclic pressure tests according to the requirement of the International Building Code.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
   1. Provide safety glazing at all locations noted below:
      a. Within 48 inches of finished floor.
      b. Immediately adjacent to any swinging door opening.
      c. At a lite within a door.
      d. Any location specifically indicated in this Section or on the Drawings to be tempered.

F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
   2. For laminated-glass lites, properties are based on products of construction indicated.
   3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
   5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
   6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

1.06 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.
   1. Weatherproofing system, including printed statement of VOC content.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
   1. Fire-rated glass.
   2. Insulating glass.
   3. Insulating spandrel glass.

C. Glazing Accessory Samples: For gaskets, in 12-inch lengths.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.07 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installers and manufacturers of insulating-glass units with sputter-coated, low-e coatings.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Warranties: Sample of special warranties.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certifieid under the National Glass Association's Certified Glass Installer Program.

B. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
   2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

E. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
   1. Provide tempered safety glass where required for compliance with CPSC 16CFR 1201 and where otherwise indicated on the Drawings.

F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

G. Preinstallation Conference: Conduct conference at Project site.
   1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review temporary protection requirements for glazing during and after installation.

1.09 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for additional mock-up requirements.

B. Locate where directed by Architect.

C. Mock-up may remain as part of the Work if approved by Architect.

1.10 DELIVERY, STORAGE AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulanting glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.12 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
   1. Warranty Period: Ten (10) years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
   1. Warranty Period: Five (5) years from date of Substantial Completion.

D. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
   1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
   1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic glass lites, properties are based on units with lites 6.0 mm thick.
   2. For laminated glass lites, properties are based on products of construction indicated.
   3. For insulating glass units, properties are absed on units of thickness indicated for overall unit and for each lite.
   4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
   5. Solar Heat-Gain Coefficiient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
   6. Visilble Reflectance: Center-of-glazing values, according to NFRC 300.

2.02 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

C. Heat-Strengthened Float Glass: ASTM C 1048; Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated; Type I, Class I (clear) unless otherwise indicated; Quality-Q3.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
   2. For coated vision glass, comply with requirements for Condition C (other coated glass).

D. Ceramic-Coated Spandrel Glass: ASTM C1048, Type I, Condition B, Quality-Q3.

2.03 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
   1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
   2. Spacer: Manufacturer's standard spacer material and construction.
   3. Desiccant: Molecular sieve or silica gel, or blend of both.

B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.

2.04 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
   1. Neoprene complying with ASTM C 864.
   2. EPDM complying with ASTM C 864.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
   1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.05 GLAZING SEALANTS

A. General:
   1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
   3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT, G, and A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 790.
      b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
      c. May National Associates, Inc.; Bondaflex Sil 290.
      d. Sika Corporation U.S.; Sikasil WS-290.
      e. Tremco Incorporated; Spectrem 1.
   2. Applications: Wet glazing for other than structural-sealant-glazed curtainwall systems.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT, G, and A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 795.
      b. GE Advanced Materials - Silicones; SilPruf SCS2000.
      c. May National Associates, Inc.; Bondaflex Sil 295.
      d. Sika Corporation U.S.; Sikasil WS-295.
      e. Tremco Incorporated; Spectrem 2.
   2. Applications: Structural-sealant-glazed curtainwall systems.

D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT, G, and A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 799.
   2. Applications: Two-sided butt-glazed glazing in interior conditions.
   3. Joint Sealant Color: Clear.

2.06 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.07 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

2.08 MONOLITHIC GLASS TYPES

A. **Glass Type GL-1**: Clear fully tempered float glass.
   1. Thickness 1/4 inch (6.0 mm) unless otherwise required to meet the performance requirements determined in the delegated design.
   2. Provide safety glazing labeling.

B. **Glass Type GL-2**: Clear fully tempered float glass.
   1. Thickness 1/2 inch (12.0 mm) unless otherwise required to meet the performance requirements determined in the delegated design.
   2. Provide safety glazing labeling.
   3. Locations: Millwork glazing, door glazing where noted, and other locations as noted in the Drawings.

C. **Glass Type GL-3**: Clear fully tempered float glass.
   1. Thickness 3/4 inch (18.0 mm) unless otherwise required to meet the performance requirements determined in the delegated design.
   2. Provide safety glazing labeling.
   3. Locations: Glass Shelves and other locations as noted in the Drawings.

2.09 LAMINATED GLASS UNITS

A. **Glass Type LG-1**: Frosted fully tempered laminated float glass.
   1. 1/2 inch (12.5 mm) Laminated Tempered Insulating glass with Frosted Glass and Low E coating.
      a. 1/4" tempered glass, 0.030 P.V.B, 1/4" tempered glass with Low E on surface #3.
   2. Provide safety glazing labeling.
   3. Location: Shower glazing and other locations as indicated in Drawings.

2.10 INSULATING GLASS UNITS

A. **Glass Type IG-1**: Low-e-coated, clear insulating glass:
   1. Products: All exterior glazing unless otherwise indicated. Subject to compliance with requirements, provide one of the following products:
      a. Guardian Industries; “SuperNeutral 68 (2) on SolarGray + Clear.”
      b. PPG Industries, Inc.; “Solarban 60 (2) Solargray + Clear.”
      c. Vitro Architectural Glass.; “Solarban 60 (2) SolarGray + Clear”
   2. Overall Unit Thickness: 1.4" (35 mm).
   3. Thickness of Each Glass Lite: 1/4" (6 mm).
   4. Outdoor Lite: Class 1 (clear) float heat strengthened glass.
   5. Low-E Coating: Second surface.
   6. Interspace Content: Air.
   7. Indoor Lite: Class 1 (clear) float glass.
   8. Visible Light Transmittance: 44 percent minimum.
   9. Winter Nighttime U-Factor: 0.29 maximum.
   10. Solar Heat Gain Coefficient: 0.29 maximum.
   11. Solar Energy Transmittance: 23 percent maximum.
   12. Ultra-Violet Transmittance: 19 percent maximum.
   13. Exterior Visible Light Reflectance: 7 percent.
   14. Provide tempered safety glazing where required for compliance with CPSC 16CFR 1201 and where otherwise indicated on the Drawings.

B. **Glass Type IG-1***: Low-e-coated, frosted insulating glass:
   1. Products: Exterior glazing including associated exterior doors to receive insulated frosted glass. Subject to compliance with requirements, provide one of the following products:
      a. Guardian Industries; “SuperNeutral 68 (2) on SolarGray + Clear with Ceramic Frit to acheive frosted glass on Surface (3)”
      b. PPG Industries, Inc.; “Solarban 60 (2) Solargray + Clear with Ceramic Frit to acheive frosted glass on Surface (3)”
      c. Vitro Architectural Glass.; “Solarban 60 (2) SolarGray + Clear with Ceramic Frit to acheive frosted glass on Surface (3).”
   2. Overall Unit Thickness: 1.4" (35 mm).
   3. Thickness of Each Glass Lite: 1/4" (6 mm).
   4. Outdoor Lite: Class 1 (clear) float heat strengthened glass.
   5. Low-E Coating: Second surface.
   6. Interspace Content: Air.
   7. Indoor Lite: Class 1 (clear) float glass.
   8. Winter Nighttime U-Factor: 0.29 maximum.
   9. Solar Heat Gain Coefficient: 0.29 maximum.
   10. Solar Energy Transmittance: 23 percent maximum.
   11. Ultra-Violet Transmittance: 19 percent maximum.
   12. Exterior Visible Light Reflectance: 7 percent.
   13. Provide tempered safety glazing where required for compliance with CPSC 16CFR 1201 and where otherwise indicated on the Drawings.

C. **Glass Type IG-1****: Low-e-coated, insulated spandrel glazing unit.
   1. Products: Subject to compliance with requirements, provide one of the following products:
      a. Guardian Industries; “SuperNeutral 68 (2) on Crystalgray + 100% Ceramic Frit (4) on Clear.”
      b. PPG Industries, Inc.; “Solarban 60 (2) Solargray + 100% Ceramic Frit (4) on Clear.”
      c. Vitro Architectural Glass.; “Solarban 60 (2) Solargray + 100% Ceramic Frit (4) on Clear.”
   2. Overall Unit Thickness: 1.4" (35 mm).
   3. Thickness of Each Glass Lite: 1/4" (6.0 mm).
   4. Outdoor Lite: Class 1 (clear) float heat strengthened glass.

5. Low-E Coating: Second surface.
6. Interspace Content: Air.
7. Indoor Lite: Class 1 (clear) float glass.
8. Ceramic Frit: Fourth surface.
    a. Ceramic Frit Color: To be selected by Architect from manufacturer's full range.
9. Winter Nighttime U-Factor: 0.29 maximum.
10. Solar Heat Gain Coefficient: 0.29 maximum.
11. Solar Energy Transmittance: 23 percent maximum.
12. Ultra-Violet Transmittance: 19 percent maximum.
13. Exterior Visible Light Reflectance: 7 percent.
14. Provide tempered safety glazing where required for compliance with CPSC 16CFR 1201 and where otherwise indicated on the Drawings.

2.11 GLAZING ACCESSORIES

A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) x width of glazing rabbet space minus 1/16 inch (1.5 mm) x height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; hardness range of 5 to 30 cured Shore A durometer; coiled on release paper; black color.
    1. Manufacturers:
        a. Pecora Corporation: www.pecora.com.
        b. Tremco Global Sealants: www.tremcosealants.com.
        c. Substitutions: Refer to Section 01 6000 - Product Requirements.

D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; _____ color.

E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
    1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
    2. Presence and functioning of weep systems.
    3. Minimum required face and edge clearances.
    4. Effective sealing between joints of glass framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Verify that openings for glazing are correctly sized and within tolerance.

D. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.02 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

C. Clean contact surfaces with solvent and wipe dry.

D. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

E. Prime surfaces scheduled to receive sealant.

3.03 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.04 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.05 FIELD QUALITY CONTROL

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.06 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.07 CLEANING

A. Remove glazing materials from finish surfaces.

B. Remove labels after Work is complete.

C. Clean glass and adjacent surfaces.

3.08 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

END OF SECTION

SECTION 08 8300 - MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Lighted Decorative mirrors.

B. Decorative mirrors.

1.02 REFERENCE STANDARDS

A. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

B. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

C. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors); 2011.

1.03 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with GANA Glazing Manual for glazing installation methods.
   1. Maintain one copy on project site.

B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with manufacturer's recommendations.

1.05 FIELD CONDITIONS

A. Do not install mirrors when ambient temperature is less than 50 degrees F (10 degrees C).

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Decorative Mirrors:
   1. Electric Mirror: www.electricmirror.com
   2. Or Prior Approved Equal.

2.02 MATERIALS

A. Decorative Lighted Mirror (Items 11 and 12 on the Toilet Accessories Legend): Lighted mirror with shadow box frame, inward facing task lighting and ambient wall glow.
   1. Glass: Lead-free, copper-free, corrosion resistant OmegaMirrror glass
   2. Size: As Indicated in Drawings
   3. One-touch dimmable inward facing task lighting
   4. One-touch dimmable wall-glow ambient lighting with diffuser
   5. Frame: Brushed Nickel
   6. Lighting Specifications:
      a. CRI: 90+
      b. CCT: 3,000 Kelvin (appears as 2,900K after diffusion)
      c. 252 lumens per foot (front light)
      d. 468 lumens per foot (wall glow)
      e. Maximum 100 lumens per watt efficacy
   7. Power Requirements:

a. 120V hardware electrical connection. Contractor to coordinate and provide junction box.
b. 24" W x 36" H: 81 W
c. 30" W x 42"H: 101 W

8. Wall clead provided for mounting to wall studs.
9. Warranty: Manufacturer's Standard 10 year warranty
10. Basis of Design: Electric Mirror Eminence LED Lighted Mirror
    a. 24" W x 36" H: Model EMN3-24.00X36.00-01L-OS-RC6.0-TD2-WG3-30K
    b. 30" W x 42" H: Model EMN3-30.00X42.00-01L-OS-RC6.0-TD2-WG3-30K

B. Decorative Lighted Mirror (Items 13 on the Toilet Accessories Legend): Lighted mirror with smooth polished edge and inner frame of frosted light.
1. Glass: Lead-free, copper-free, corrosion resistant OmegaMirrror glass
2. Size: As Indicated in Drawings
3. Forward facing task lighting
4. Dimmable 0-10V
5. Lighting Specifications:
    a. CRI: 90+
    b. CCT: 3,000 Kelvin (appears as 2,900K after diffusion)
    c. 604 lumens per foot
    d. Maximum 100 lumens per watt efficacy
6. Power Requirements:
    a. 120V-240V hardware electrical connection. Contractor to coordinate and provide junction box.
7. Mounting holes provided for mounting to wall studs.
8. Warranty: Manufacturer's Standard 10 year warranty
9. Basis of Design: Electric Mirror Integrity LED Lighted Mirror
    a. 30" W x 72" H: Custom Size

C. Decorative Metal Framed Mirror (Items 14 and 15 on the Toilet Accessories Legend): Metal framed mirror.
1. Glass: Lead-free, copper-free, corrosion resistant OmegaMirrror glass
2. Size: As Indicated in Drawings
3. Frame Material: Corrosion-Resistant Aluminum with tight-mitered corners
4. Frame Finish: Brushed Nickel
5. Frame Width: 3/4"
6. Hardware: Precision metal inserts, secured with dual friction set hardware
7. Warranty: Manufacturer's Standard 10 year warranty
8. Basis of Design: Electric Mirror Metal Framed Mirror
    a. 24" W x 36" H
    b. 30" W x 72" H

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for mirrored glazing are correctly sized and within tolerance.

B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.

C. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install mirrors in accordance with manufacturer's recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

3.04 CLEANING

A. Remove wet glazing materials from finish surfaces.

B. Remove labels after work is complete.

C. Clean mirrors and adjacent surfaces.

3.05 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

END OF SECTION

SECTION 08 8723 - DECORATIVE FILMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Decorative Glazing films applied to new glazing assemblies.

B. Glazing assemblies to receive film are indicated on drawings.

1.02 RELATED REQUIREMENTS

A. Section 08 8000 - Glazing: New glazing to received film.

1.03 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Record of product certification for safety requirements.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.

C. Shop Drawings: Detailing installation of film, anchoring accessories, and sealant.

D. Samples: For each film product to be used, minimum size 4 inches (102 mm) by 6 inches (152 mm), representing actual product, color, and patterns.

E. Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies identical to those required for this project.

F. Specimen Warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Glazing film manufacturer specializing in manufacture of safety glazing films with minimum 10 years successful experience.

B. Installer Qualifications: Certified by glazing film manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of authorities having jurisdiction.

1.06 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 WARRANTY

A. Provide 5 year manufacturer's replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. **DF-1** - Solyx: www.solyxfilms.com

B. Or prior approved equal.

2.02 MATERIALS

A. Decorative Glazing Films **(DF-1)**: Transparent, transluscent or patterned polyester film for permanent bonding to glass.
   1. Basis of Design: Solyx SC-3131 Eco Dusted
   2. Thickness: 3 mil
   3. Film Type: Polyester

4. Opacity: Frosted
5. Adhesive Type: Clear, pressure sensitive acrylic, permanent adhesive.
6. Shading Coefficient: .93
7. Visible Light Reflection: 69%
8. Visible Light Transmission: 59%
9. UV Transmission: 45%
10. Solar Heat Reflection: 68%
11. Solar Heat Transmission: 32%
12. Infra-Red Transmission: 66%

B. Accessory Materials: As recommended or required by film manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine glass and frames. Verify that existing conditions are adequate for proper application and performance of film.

B. Verify glass is not cracked, chipped, broken, or damaged.

C. Verify that frames are securely anchored and free of defects.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.

B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.

C. Protect adjacent surfaces.

D. Do not begin installation until substrates have been properly prepared.

3.03 INSTALLATION

A. Do not apply glazing film when surface temperature is less that 40 degrees F (4 degrees C) or if precipitation is imminent.

B. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.

C. Accurately cut film with straight edges to required sizes allowing 1/16 inch (2 mm) to 1/8 inch (3 mm) gap at perimeter of glazed panel unless otherwise required by anchorage method.

D. Seams: Seam film only as required to accommodate material sizes; form seams vertically without overlaps and gaps; do not install with horizontal seams.

E. Clean glass and anchoring accessories following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.

F. Remove labels and protective covers.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 09 2116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Cementitious backing board.

E. Gypsum wallboard.

F. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 07 2100 - Thermal Insulation: Acoustic insulation.

C. Section 07 8400 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.

D. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.

B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).

C. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).

D. ANSI A108.11-SystemDeleted - American National Standard for Interior Installation of Cementitious Backer Units; 2010 (Revised).

E. ANSI A118.9-SystemDeleted - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2010).

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

G. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.

H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.

I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.

J. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.

K. ASTM C1325 - Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units; 2014.

L. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.

M. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.

N. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.

O. ASTM E413 - Classification for Rating Sound Insulation; 2010.

P. GA-216 - Application and Finishing of Gypsum Board; 2013.

Q. UL (FRD) - Fire Resistance Directory; current edition.

R. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of experience.

B. Single Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board or from a manufacturer acceptable to gypsum board manufacturer.

1.06 MOCK-UP

A. Apply mock-ups of each wall texture and finish level system indicated to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each texture and finish level system specified.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
      b. Other items: Architect will designate items or areas required.
   2. Final approval of finish and texture selections will be based on mockups.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface combination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

C. Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.08 PROJECT CONDITIONS

A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.

B. Room Temperatures: Maintain not less than 40 deg F (4 deg C). For finishing of gypsum board, maintain not less than 50 deg F (10 deg C) for 48 hours prior to application and continuously after until dry. Do not exceed 95 deg F (35 deg C) when using temporary heat sources.

C. Ventilation: Ventilate building spaces, as required, for drying joint treatment materials. Avoid drafts during hot dry weather to prevent finishing materials from drying too rapidly.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
   1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

A. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com.
   2. Marino: www.marinoware.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf (240 Pa), or minimum code requirement, whichever is greater. Provide a minimum 20 gauge, Maximum 16" spacing between studs.
   1. Studs: "C" shaped with knurled or emobossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
   4. Resilient Furring Channels: Single or double leg configuration; 1/2 inch (12 mm) channel depth.

C. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 4000.

D. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

E. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
   3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
   4. Deflection and Firestop Track:
      a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
      b. Products:
         1) FireTrak Corporation; Posi Klip.
         2) Metal-Lite, Inc.; The System.
   5. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet (3660 mm).

2.03 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

A. General: Provide components of sizes indicated but not less than that required to comply with ASTM C 754 for conditions indicated.

B. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.

C. Carrying Channels: Cold-rolled steel, 0.05980-inch-minimum thickness of base (uncoated) metal and 7/16-inch-wide flanges, 1-1/2 inch deep, 475 lb. per 1000 feet, rust-inhibitive paint finish. Use for primary suspension members where indicated.

D. Steel Studs for Furring: ASTM C 645, with flange edges bent back 90 deg and doubled over to form 3/16-inch minimum lip (return), minimum thickness of base (uncoated) metal 0.0179 inch

(nominal 25 ga.) unless otherwise indicated. Use for primary suspension members where indicated.
1. Depth as indicated.
2. Manufacturer's standard corrosion-resistant coating.

E. Steel Rigid Furring Channels: ASTM C 645, hat shaped, and minimum thickness of base (uncoated) metal 0.0179 inch (nominal 25 ga.) unless otherwise indicated. Use for secondary suspension members where indicated.
1. Depth - 7/8 inch and 1 1/2 inch.
2. Protective Coating: Manufacturer's standard corrosion-resistant coating.

F. Suspension System: Manufacturer's standard direct-hung grid suspension system complying with ASTM C 645 and composed of main beams and cross furring members that interlock to form a modular supporting network. Provide one of the following or Architect-approved substitute system:
1. Chicago Metallic Corp. 630.
2. National Rolling Mills, Inc. DFS Series.
3. USG Interiors, Inc. Donn Rigid X Drywall Suspension System.
4. Substitutions: Under provisions of Section 016000

2.04 BOARD MATERIALS

A. General: Provide gypsum board of types indicated in maximum lengths available to minimize end-to-end butt joints. Provide 5/8 inch thickness unless otherwise indicated.

B. Manufacturers - Gypsum-Based Board:
1. American Gypsum Company: www.americangypsum.com.
2. Georgia-Pacific Gypsum: www.gpgypsum.com.
3. National Gypsum Company: www.nationalgypsum.com.
4. USG Corporation: www.usg.com.

C. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   a. Mold resistant board is required at all locations.
3. Thickness:
   a. Vertical Surfaces: 5/8 inch (16 mm).
   b. Ceilings: 5/8 inch (16 mm).
4. Mold Resistant Paper Faced Products:
   a. American Gypsum Company; M-Bloc Type X.
   b. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard.
   c. National Gypsum Company; Gold Bond XP Gypsum Board.
   d. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels..

D. Backing Board For Wet Areas: One of the following products:
1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
2. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
   a. Thickness: 1/2 inch (12.7 mm).
   b. Products:
      1) National Gypsum Company; PermaBase Cement Board: www.nationalgypsum.com/#sle.
      2) USG Corporation: www.usg.com.
      3) Or approved equal.

E. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Application: Ceilings, unless otherwise indicated.
2. Thickness: 5/8 inch (16 mm), unless otherwise indicated.
3. Edges: Tapered.

2.05 GYPSUM WALLBOARD ACCESSORIES

A. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

B. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.
   2. Typical Accessories: Provide corner beads, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:
      a. Material: Formed sheet steel or zinc, or metal combined with paper, with sheet steel coated with zinc by hot-dip or electrolytic processes, or with aluminum.
      b. Shapes as indicated by reference to designations in ASTM C 1047:
         1) Corner bead on outside corners, unless otherwise indicated.
         2) LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-bead for edge trim unless otherwise indicated.
   3. Aluminum Accessories: Where indicated, provide manufacturer's standard extruded aluminum accessories of profile indicated or referenced by manufacturer's product designations, with the following finish:
      a. Class II Color Anodized Finish: AA-C12C22A32/A34, as selected from manufacturer's full range.
         1) Manufacturer: Subject to compliance with requirements, provide aluminum accessories of one of the following:
            (a) Fry Reglet Corp.
            (b) Gordon, Inc.
            (c) MM Systems, Inc.
         2) One-piece control joint formed with V-shaped slot, with removable strip covering slot opening.
   4. Special Shapes: In addition to convential cornerbead and control joints, provide U-bead and J-bead at exposed panel edges.
   5. Products:
      a. Same manufacturer as framing materials.

C. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
   1. Product: SpeedSkim manufactured by Freeman Products, Inc.

D. Corrosion-resistant-coated steel drill screws of size and type recommended by board manufacturer for fastening cementitious backer units.

E. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

F. Fry Reglet trim shapes as indicated on plans.
   1. Color and finish as selected from Manufacturer's full range of colors.

G. Spot Grout: ASTM C 475, setting-type joint compound recommended for spot grouting hollow metal door frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

B. Project Conditions: Verify that installation conditions specified in PART 1 - GENERAL have been achieved and can be maintained.
   1. Related Work: Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing for installation

tolerances and other conditions affecting installation and performance of gypsum board assemblies.

2. Acceptance: Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Supplemental Framing: Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies and to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with "Gypsum Construction Handbook" published by United States Gypsum Co.

C. Structural Isolation: Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
   1. Where building structure abuts ceiling perimeter or penetrates ceiling.
   2. Where partition framing and wall furring abut structure except at floor.
   3. Provide slip- or cushioned type joints as necessary to attain lateral support and avoid axial loading.

D. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Level ceiling system to a tolerance of 1/1200.
   2. Laterally brace entire suspension system.
   3. Install bracing as required at exterior locations to resist wind uplift.

E. Studs: Space studs at 16 inches (400 mm) on center, unless indicated otherwise.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

F. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

3.03 WALL FRAMING

A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.
   1. Space studs and furring members 16" o.c. unless otherwise indicated.
   2. Where studs are installed directly against exterior walls, install asphalt felt strips between studs and wall.
   3. Install steel studs and furring in sizes and at spacing indicated but not less than that required to comply with maximum deflection and minimum loading requirements specified in PART 2 - PRODUCTS.

B. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch from the plane formed by the faces of adjacent framing.

C. Full Height Partitions: Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Cut studs 1/2 inch short of full height.
   1. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
   2. Extend partitions to the underside of floor/roof slabs and decks or other continuous solid structural surfaces. Install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.

D. Ceiling Height Partitions: Terminate partition framing at suspended ceilings where indicated. Extend jamb studs at door openings through suspended ceilings and attach to underside of structure above.

E. Stud Framing:
   1. Install steel studs vertically, engaged in floor and ceiling runners, and with open sides facing in the same direction and so that leading edges or ends of each gypsum board can be attached to open (unsupported) edges of stud flanges first. Position framing to provide support for all gypsum board edges (for vertical board application) or ends (for horizontal board application).
   2. For curved partitions install steel framing as follows:
      a. Cut top and bottom runners through leg and web at 2-inch intervals for arc length. In cutting lengths of runners allow for uncut straight lengths of not less than 12 inches at ends of arcs.
      b. Bend runners to uniform curve of radius indicated and locate straight lengths so they are tangent to arcs.
      c. Support outside (cut) leg of runners by clinching a 1-inch-high by 0.0209-inch (25-gage)-thick sheet steel strip to inside of cut legs using metal lock fasteners.
      d. Attach runners to structural elements at floor and ceiling with fasteners located 2 inches from ends and spaced 24 inches o.c.
      e. Attach runners to suspended ceilings with toggle bolts or hollow wall anchors located 2 inches from ends and spaced 16 inches o.c. in between where attached to suspended ceilings.
      f. Begin and end each arc with a stud and space intermediate studs equally along arcs at stud spacing recommended by gypsum board manufacturer for radiuses indicated. Attach studs to runners with 3/8-inch-long pan head framing screws. On straight lengths at ends of arcs, place studs 6 inches o.c. with last stud left free standing.
   3. Frame door openings with two 20 ga. studs at each jamb to comply with details indicated and with applicable published recommendations of gypsum board manufacturer. Attach vertical studs at jambs with screws to runner tracks and to jamb anchor clips on door frames. Install runner track section (for cripple studs) at head and secure to jamb studs.
   4. Frame openings other than door openings in same manner as required for door openings, except that jamb studs will not be required to be 20 ga. Install framing below sills of openings to match framing required above door heads.

F. Wall Furring:
   1. Space furring members 16 inches on centers unless otherwise indicated. Attach with 2-inch cut nails driven into masonry joints or with power-driven fasteners. Space fasteners 24 inches apart, staggered from flange to flange.
   2. Install furring members around openings, ducts, structural members, and other penetrations as needed to support gypsum board.
   3. Position furring members to provide support for all gypsum board edges (for vertical board application) or ends (for horizontal board application)

G. Blocking: Install mechanically fastened steel channel blocking for support of:
   1. Framed openings.
   2. Wall mounted cabinets.
   3. Plumbing fixtures.
   4. Toilet partitions.
   5. Toilet accessories.
   6. Wall mounted door hardware.
   7. Fire Extinguisher Cabinets.
   8. Other items as required.

3.04 INSTALLING STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

A. General: At the option of the Installer, any of the following framing methods may be used.

1. Main runners (carrying channels or metal studs) suspended from overhead structure and cross furring (rigid furring channels).
2. Steel studs, suspended or attached to adjoining wall/partition structure. Unless otherwise indicated or required, use 3-5/8" studs, maximum 24" o.c., for spans up to 8'-0".
3. Proprietary suspension system.

B. Coordination: Coordinate layout and installation of ceiling suspension system with other work above, supported by and penetrating ceilings.

C. Hangers: Suspend ceiling hangers from building structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacing that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
4. Do not connect or suspend steel framing from ducts, pipes or conduit.

D. Installation Tolerances: Install steel framing components for suspended ceilings so that cross furring members or grid suspension members are level to within 1/8 inch in 12 ft. as measured both lengthwise on each member and transversely between parallel members.

E. Suspended Framing:
1. Provide hangers not closer than 6" to ends of primary members.
2. Locate both primary and secondary members not more than 6" from walls and partitions which interrupt ceilings.
3. Provide 1" clearance between ends of framing members and abutting walls and partitions.
4. Sway-brace suspended steel framing with hangers used for support.

F. Suspended Steel Framing: Install components in sizes and at spacing indicated but not less than that required by referenced steel framing installation standard.
1. Wire Hangers: 0.1620 inch diameter (8 gage), 4 ft. on center maximum.
2. Primary Members (main runners): Carrying channels or steel studs, 4 feet on center, maximum.
3. Secondary members (cross furring): Hat-shaped channels, 24 inches on center, maximum.
4. Wire-tie or clip furring members to main runners and to other structural supports as indicated.

G. Proprietary Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross furring members to each other and butt cut to fit into wall track. Comply with system manufacturer's instructions.

3.05 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.06 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

D. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

E. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

F. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

3.07 APPLYING AND FINISHING GYPSUM BOARD

A. General Standards: Install and finish gypsum panels to comply with ASTM C 840 and gypsum board manufacturer's recommendations.
   1. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
   2. Locate either edge or end joints over supports. Position boards so that tapered edges abut tapered edges and mill-cut or field-cut ends abut mill-cut or field-cut ends. Do not place tapered edges against cut edges or ends.
   3. Locate exposed end-butt joints as far from centers of walls and ceilings as possible, and stagger not less than 24 inches in alternate courses of board.
   4. Fit gypsum board neatly around ducts, pipes, conduits, and other penetrating items, and around openings for electrical devices, fixtures, accessories and similar recessed items.
   5. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.
   6. Form control joints and expansion joints at locations indicated, with space between edges of boards, prepared to receive trim accessories.
   7. Where gypsum board intersects beams, joists, columns and other structural components, cut gypsum board to fit profile of component and allow 1/4 to 1/2 inch wide joint for sealant.

B. Ceilings: Install ceiling boards across supports in the manner which minimizes the number of end-butt joints, and which avoids end joints in the central area of each ceiling. Stagger end joints at least 24 inches.

C. Walls and Partitions: Install wall/partition boards with 1/4-inch gap at floor and in manner which avoids end-butt joints entirely where possible.
   1. At walls more than 12 feet high, install boards horizontally with end joints staggered over studs.
   2. Stagger gypsum board joints over different studs on opposite faces of partitions.
   3. Cover both faces of partition framing with gypsum board in concealed spaces (above ceilings, etc.), except in chase walls.
   4. Attach gypsum board to steel studs so that leading edge or end of each board is attached to open (unsupported) edge of stud flange first.
   5. Spot grout hollow metal door frames for solid core wood doors, hollow metal doors and doors over 32 inches wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panel into frames.
   6. Isolate perimeter of non-load-bearing partitions at structural abutments. Provide 1/4 inch to 1/2 inch space, and where exposed in the completed construction, trim edge with edge trim. Seal joints with acoustical sealant, except at fire-rated partitions joints shall be fire-stopped as specified in Section 078400.

3.08 GYPSUM BOARD APPLICATION METHODS

A. General: Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.

B. Single Layer Application: Install gypsum board as follows:
   1. On ceilings, apply gypsum board prior to wall/partition board application to the greatest extent possible and at right angles to supports, unless otherwise indicated. Provide lengths that will avoid or minimize end joints.
   2. On partitions/walls, apply gypsum board horizontally (perpendicular to supports), unless parallel application is required for fire-resistive-rated assemblies. Use maximum length panels to avoid or minimize end joints. Stagger joints on opposite sides of partitions.
   3. On furring members, apply gypsum board vertically (parallel to supports) with no end joints. Locate edge joints over furring members.

C. Single Layer Fastening Methods: Apply gypsum panels to supports as follows:
   1. Fasten to steel framing with screws.
   2. Fasten to wood supports with screws or double nailing.

D. Sound Attenuation: Install insulation after framing is complete and piping, conduits, ducts and other penetrating items are complete and tested. Install insulation to form a continuous sound barrier the full height and width of the partition.
   1. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
   2. Acoustic Sealant: Install in accordance with manufacturer's instructions.
      a. Place continuous bead at perimeter of each layer of gypsum board.
      b. In non-fire-rated construction, seal around all penetrations by conduit, pipe, ducts, and rough-in boxes.

3.09 INSTALLATION OF TRIM AND ACCESSORIES

A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners. Provide trim as follows.
   1. Install corner beads at all external corners.
   2. Install edge trim where edge of gypsum panels would otherwise be exposed and where gypsum panels are tightly abutted to other construction. Provide edge trim type with face flange formed to receive joint compound except where other types are indicated.
   3. Install aluminum edge trim and other accessories where indicated.

B. Control Joints: Install control joints at locations indicated, and where not indicated in locations approved by Architect for visual effect according to the following requirements:
   1. In ceilings: Not more than 30 feet apart in any direction (50 feet if perimeter relief exists), and wherever support framing or furring changes direction.
   2. In walls/partitions: Not more than 30 feet apart, and wherever a control joint occurs in an exterior wall which services as a base for gypsum board finish. Wall or partition height door frames may be considered control joints.

3.10 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads and surface defects; and elsewhere as required to prepare gypsum board surfaces for decoration and levels of gypsum board finish indicated.
   1. Pre-fill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.
   2. Apply joint tape over gypsum board joints and to face flanges of aluminum and other trim accessories as recommended by trim accessory manufacturer to prevent cracks from developing in joint compound at flange edges.

B. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214, or as specified in the drawings. All new construction painted exposed gypsum board surfaces to be Level 5 finish, unless otherwise indicated. All gypsum board surfaces to receive full wall graphics or specialty paint features shall be Level 5 finish.
   1. Level 0 for temporary construction or where indicated in drawings.

a. No taping, finishing or accessories required.

2. Level 1 for ceiling plenum areas, concealed areas, or where indicated in drawings, unless a higher level of finish is required for fire-resistive-rated assemblies and sound-rated assemblies, apply joint compound specified for embedding coat.
   a. Embedding and First Coat: Ready-mixed, drying-type, all-purpose or taping compound.
      1) Tool marks and ridges acceptable. Surface free of excess joint compound.
3. Level 2 for mechanical & electrical areas, behind cabinetry, backing board to receive a tile finish and where indicated in drawings.
   a. Embedding and First Coat: Ready-mixed, drying-type, all-purpose or taping compound. Whip compound with joint knife leaving a thin coat of compound over tape.
      1) Surface shall be free of access joint compound. Tool marks and ridges acceptable. Joint compound applied over body of the tape at the time of tape embedment shall be considered a separate coat of joint compound and shall satisfy the condition of this level.
4. Level 3 walls to receive textured wall finish in locations indicated in drawings.
   a. Embedding and First Coat: Ready-mixed, drying-type, all-purpose or taping compound.
      1) Fill (Second) Coat: Ready-mixed, drying-type, all-purpose or topping compound.
      2) Accessories and fasteners shall be covered by two separate coats of joint compound.
      3) Joint compound shall be smooth and free of tool marks and ridges.
      4) Prepare surface to be coated with drywall primer prior to the application of final finishes.
5. Level 4 gypsum board finish, embed tape in finishing compound plus two separate coats applied over joints, angles, fastener heads, and trim accessories using the following joint compounds (not including pre-fill), and sand between coats and after last coat:
   a. Embedding and First Coat: Ready-mixed, drying-type, all-purpose or taping compound.
      1) Fill (Second) Coat: Ready-mixed, drying-type, all-purpose or topping compound.
         (a) Finish (Third) Coat: Ready-mixed, drying-type, all-purpose or topping compound.
         (b) Accessories and fasteners shall be covered by two separate coats of joint compound.
         (c) Joint compound shall be smooth and free of tool marks and ridges.
         (d) Prepare surface to be coated with drywall primer prior to the application of final finishes.
         (e) Prepare and submit a 24”x24” review sample for Architect’s approval as per following specification prior to commencement of finishing of this level type.
         (f) In lieu of finish listed above, contractor has the option where Level 4 finish is indicated, spray apply high build drywall surfacer (listed in 2.5 E) over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
6. Level 5 for gypsum board surfaces indicated to receive gloss and semi-gloss paints, enamel paints, non-textured walls to receive flat paints, all gypsum board surfaces to receive full wall graphics or specialty paint features and where indicated in drawings.
   a. Where Level 5 finish with light texture gypsum board finish is indicated, provide finish specified for level 4 plus a thin, uniform skim coat of joint compound over entire surface. Use a joint compound specified for the finish (third coat) or a product specially formulated for this purpose and acceptable to gypsum board manufacturer.
   b. Produce surfaces free of tool marks and ridges ready for decoration of type indicated. Refer to ASTM C 840.

c. In lieu of finish listed above, contractor has the option where Level 5 finish is indicated, spray apply high build drywall surfacer (listed in 2.5 E) over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.11 CLEANING AND PROTECTION

A. Cleaning: Promptly remove any residual joint compound from adjacent surfaces.

B. Protection: Provide final protection and maintain conditions that ensure gypsum board assemblies remain without damage or deterioration at time of Substantial Completion.

3.12 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION

SECTION 09 3000 - TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Stone thresholds.

D. Ceramic accessories.

E. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

B. Section 09 2116 - Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

A. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2017.

B. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).

C. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.

D. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2012.

E. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, water proof membrane, and accessories. Include instructions for using grouts, water proof membrane, and adhesives.

C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.

D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches (457 by 457 mm) in size illustrating pattern, color variations, and grout joint size variations.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Tile: 1 percent of each size, color, and surface finish combination, but not less than 10 s.f. of each type.

1.05 QUALITY ASSURANCE

A. Maintain one copy of and ANSI A108/A118/A136.1 and TCNA (HB) on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

C. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.

B. Construct tile mock-up where required by Architect, incorporating all components specified for the location.
   1. Minimum size of mock-ups is 10' X 10", required for walls & floors.
   2. Approved mock-up may remain as part of the Work.
   3. Demolish mock-up when directed by Architect, and remove debris from the site.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during installation of mortar materials.

1.09 WARRANTY

A. Floor and Wall Tile: Provide manufacturers standard warranty.

B. Shower Systems and Floor Drains: Provide manufacturers warranty to be free of manufacturing defects, deterioration or break down under normal use for a perod of ten (10) years.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers **(TL-1, TL-2, TL-3, TL-4, TL-5, TL-6, TL-7, TL-8, TL-9)**:
   1. Basis of Design Product: Subject to compliance with requirements, provide the products listed in the Drawing Finish Key. Specific tiles are identified in the drawings to establish the color, design intent, and required standard of quality. It is not the intent to preclude the use of other prior approved, acceptable manufacturers
      a. Porcelain Tile and Base: Manufacturers, Styles, Colors and Installation Patterns, as indicated in Drawing Finish Key, Finish Plans, and Interior Elevations.
      b. Ceramic Tile and Base: Manufacturers, Styles, Colors and Installation Patterns as indicated in Drawing Finish Key, Finish Plans, and Interior Elevations.
   2. Anatolia BPI
   3. Daltile
   4. Ceramic Technics
   5. Coastal Tile
   6. Concept Surfaces
   7. Garden State Tile
   8. Porcelanosa
   9. Tilebar
   10. Or Prior Approved Equal

2.02 WATERPROOFING MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is acceptable to authorities having jurisdiction for use as shower pan waterproofing, as selected from one of the following available options. Include primer, pre-fabricated corners, seaming cement, detail tape sealant, integrated drain and other standard accessory products required for application provided by membrane manufacturer.

B. Material Description: 0.020 inch thick, polyethylene membrane, with polypropylene fleece laminated on both sides, which meet or exceed the requirements of the "American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation A118.10", and is listed by cUPC, and is evaluated by ICC-ES (see Report No. ESR-2467 and PMG 1204).

C. Manufacturer:
   1. Schluter-KERDI DS, as manufactured by Schluter Systems.
   2. Durock membrane, as manufactured by USG.

D. Accessories:
   1. Waterproofing seaming membrane.
      a. Basis of Design: Provide Schluter®-KERDI-BAND Seams and Corners material 0.004" (4 mil) thick, orange polyethylene membrane, with polypropylene fleece laminated on both sides.
   2. Mixing Valve seals and pipe seals.
      a. Basis of Design: Kerd-Seal Mixing Valve Seals and Kerd-Seal Pipe Seals

E. Shower System and Drain
   1. Point Drain: Stainless steel floor drain 9-27/32" (250 mm) diameter integrated bonding flange with no-hub outlet, and grate assembly. Grate
      a. Basis of Design Manufacturer:
         1) Schluter Kerdi-Drain (Stainless Steel), as manufactured by Schluter Systems
      b. Drain housing material: Stainless Steel
      c. Grate Design, Material and Finish:
         1) Floral – Petal-shaped openings
            (a) EB –Stainless Steel Type 304, Brushed
      d. Nominal Grate Size:
         1) 6" (150 mm) x 6" (150 mm) square
      e. Drain Outlet:
         1) 3" (75 mm) outlet, unless otherwise indicated in Plumbing Drawings. Contractor to Coordinate.
   2. Trench Drain: Linear floor drain consisting of a formed stainless steel channel body and grate assembly that can be seamlessly adjusted to tile or stone covering thickness from 1/8 inch (3 mm) to 1 inch (25 mm). The channel body features a 2-1/4 inch (57 mm) wide trough, a 2 inch (50 mm) no-hub outlet and a 7/8 inch (22 mm) wide bonding flange laminated with a collar made of the Schluter-KERDI waterproofing membrane. Drain type as referenced in methods B422, B422C and B422 STONE in the Tile Council of North America Handbook for Ceramic, Glass, and Stone Tile Installation. Drain shall attach directly to the waste line.
      a. Basis of Design Manufacturer:
         1) Schluter Kerdi-Line, as manufacturered by Schluter Systems
      b. Channel Body and Grate Nominal Length:
         1) 2-1/8" (54 mm) by full length of shower
      c. Grate Frame Height:
         1) 1-1/8" (30 mm)
      d. Grate Material and Finish:
         1) EB –Closed Solid Brushed Stainless Steel Type 304 = V2A
      e. Drain Outlet:
         1) Location as Indicated in Drawings.
      f. Drain Grate Connector Plate:
         1) EB – Brushed Stainless Steel Type 304 = V2A
      g. Drain outlet: 3" no hub outlet unless otherwise indicated in Plumbing Drawings. Contractor to coordinate.
      h. Installation location: Where indicated in Drawings
   3. Shower System
      a. Provide Schluter Kerdi-Shower accessories as necessary to ensure a fully sealed watertight condition at all walls, floors, and transitions related to the shower assembly and associated plumbing penetrations.
         1) Waterproofing membrane Basis of Design: Schluter-Kerdi-DS, as manufactured by Schluter Systems.
   4. Shower Niche (Items 22 and 23 on the Toilet Accessories Legend): : Prefabricated waterproof niche, constructed of rigid extruded polystyrene foam building element panel, with reinforcement material and polypropylene fleece webbing laminated on both sides for thin-set ceramic tile and dimension stone Installations.

a. Fully waterproof and vapor-tight.
b. Features sealed inside corners for effective waterproofing
c. Basis of Design: Schluter KERDI-BOARD-SN
1) KB 12 SN 305 305 A – 12” by 12” by 3 1/2” (305 mm by 305 mm by 89 mm)
2) KB 12 SN 305 508 A1 – 12” by 20” by 3 1/2” (305 mm by 508 mm by 89 mm)

2.03 CRACK ISOLATION MEMBRANE UNDERLAYMENTS

A. General: Manufacturer's standard product that complies with ANSI A118.12 as selected from one of the following options. Include primer, pre-fabricated corners, seaming cement, detail tape, sealant, and other standard accessory products required for application provided by membrane manufacturer.

B. Fluid-Applied Crack Isolation Membrane Underlayment:
1. Description: Manufacturer's proprietary system consisting of liquid applied component and synthetic fabric sheet reinforcement.
2. Manufacturers and Products:
a. **Basis of Design**: Custom Building Products: RedGard Waterproofing and Crack Prevention Membrane.
b. Laticrete International Inc.; Laticrete 9235 Waterproof Membrane.
c. Laticrete International Inc.; Blue 92 Anti-Fracture Membrane.
d. Mapei Corp; Mapelastic HPG.

C. Fluid-Applied Waterproofing and Crack Isolation Membrane to be installed on ALL walls with tile in restrooms, a minimum of 6" up walls from finish floor.

2.04 SETTING MATERIALS

A. Manufacturers:
1. Custom Building Products.
2. MAPEI Corporation.
3. Summitville Tiles, Inc.

B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:
1. Prepackaged dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive.
a. For wall applications, provide non-sagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.

C. Medium Thin-set Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for thin-set application.
1. Basis of Design Product: Subject to compliance with requirements, provide Custom Building Products MegaLite Non-Sag Rapid Set Mortar or a comparable product from one of the following:
a. MAPEI Corporation; Ultraflex LFT.
b. Summitville Tiles, Inc.; S-1200 MP Premium Medium Bed Mortar.
2. Application: Large format tile installations. Refer to the Drawing Finish Legend for tile sizes.

D. For wall applications, provide mortar that complies with requirements for non-sagging mortar in addition to the other requirements in ANSI A118.4.

2.05 GROUT MATERIALS

A. Manufacturers:
1. Basis of Design: Laticrete Epoxy Grout
2. Custom Building Products
3. MAPEI Corporation
4. Summitville Tiles, Inc.

B. Water-Cleanable Epoxy Grout: ANSI A118.3.

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.06 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants".
   1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      a. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

2.07 CEMENTITIOUS BACKER UNITS

A. Refer to Section 09 2116 "Gypsum Board Assemblies" for cementitious tile backer board to be provided by that Section.

2.08 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
   1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F per ASTM D 87.
   2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

D. Edge Strips (Where Indicated): Angle, radius or L-shape, height to match tile and setting-bed thickness, metallic or PVC or neoprene base, designed specifically for flooring applications.
   1. Basis of Design Product: Schluter Systems, LP transitions and reducers or a comparable approved product of one of the following:
      a. Blanke Corporation
      b. Ceramic Tool Company, Inc.
   2. Tile to Carpet: Schluter - Model as indicated on drawings.
   3. Tile to Tile, Edge Termination or Transitions As Indicated: Schluter - Model as indicated on drawings.
   4. Tile to Wood Flooring: Schluter - Model as indicated on drawings.
   5. Tile Floor to Wall Transition: Schluter - Model as indicated on drawings.
   6. Tile Expansion Joints: Schluter - Model as indicated on drawings.

2.09 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
   1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
   2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
      a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
      b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
   3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
   4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.03 WATERPROOF MEMBRANE UNDERLAYMENT INSTALLATION

A. Installation Quality Standard: ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

B. General Requirements:
   1. If required by manufacturer, prime concrete substrate.
   2. Install to produce a continuous waterproof membrane of uniform thickness bonded securely to substrate, without wrinkles, bubbles, buckles or kinks.
   3. For sheets, overlap and seal seams.
   4. Turn membrane up wall at locations where tile is scheduled for wall or base.
   5. Roll installed sheet if required by manufacturer.
   6. Install tile after waterproofing has cured and been testing determined it is watertight.

3.04 CRACK ISOLATION MEMBRANE UNDERLAYMENT INSTALLATION

A. General Requirements:
   1. If required by manufacturer, prime concrete substrate.
   2. Install to produce a continuous crack isolation membrane of uniform thickness bonded securely to substrate, without wrinkles, bubbles, buckles, or kinks.
   3. For sheets, overlap and seal seams.
   4. For liquid applied products, brush or roll liquid uniformly over area in number of coats required and install reinforcing fabric.

5. Roll installed sheet if required by manufacturer.
6. After installation of tile, install floor joint sealant in tile joints recommended by manufacturer to coordinate with membrane strips.

3.05 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
   1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
      a. Tile floors in wet areas.
      b. Tile floors composed of tiles 8 by 8 inches or larger.

B. Extend tile work into recesses and under or behind millwork, casework, equipment and fixtures to form complete floor and/or wall covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetratioins so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
   2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Porcelain Paver Tile: 1/8 inch or according to manufacturer's recommendation.
   2. Porcelain Mosaic Tile: 1/16 inch or according to manufacturer's recommendation.

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
   2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealers".

I. Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

J. Grout tile to comply with requirements of the following tile installation standards:
   1. For epoxy tile grouts, comply with ANSI A108.6.

3.06 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with The Tile Council of North America Handbook Method F113, dry-set or latex-Portland cement bond coat, with epoxy grout, unless otherwise indicated.
   1. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCNA (HB) Method F115.

B. Field-Applied Temporary Protective Tile Coating: Apply a continuous film to protect tile surfaces from adhesion of grout.

C. Back Buttering: Produce 100 percent mortar coverage on tile backs to comply with applicable special requirements for back buttering in ANSI A108 Series tile installation standards in the following locations:
   1. Floors in wet areas.
   2. Floors composed of 8-by-8-inch tile or larger.
   3. Floors composed of rib-backed tiles.

D. Blending: For tile with color variations, install blended tiles to produce color variations that match approved Samples.

E. Extend tile work into recesses and under or behind millwork, casework, equipment and fixtures to produce a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

F. Accurately form intersections and returns. Cut and drill tile without marring visible surfaces. Grind cut edges of tile abutting trim, finish, or built-in items to produce straight aligned joints. Fit tile to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

G. Jointing Pattern: Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths.
   1. Lay tile in grid pattern.

H. Joint Widths: Produce uniform joint widths as follows:
   1. Per manufacturer’s recommendations

I. Expansion Joints: Form expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Locate joints in tile surfaces directly above joints in concrete substrates, and as recommended by tile manufacturer and or TCA for area covered.
   2. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."

J. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile, unless otherwise indicated.

K. Stone Thresholds: Install stone thresholds set in same type of setting bed as abutting field tile, unless otherwise indicated.
   1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent non-tile floor finish.

3.07 INSTALLATION - WALL TILE

A. Over cementitious backer units install in accordance with TCNA (HB) Method W223, organic adhesive.

B. Field-Applied Temporary Protective Tile Coating: Apply a continuous film to protect tile surfaces from adhesion of grout.

C. Back Buttering: Produce 100 percent mortar coverage on tile backs to comply with applicable special requirements for back buttering in ANSI A108 Series tile installation standards in the following locations:
   1. Wall installations composed of 8-by-8-inch tile or larger.

D. Blending: For tile with color variations, install blended tiles to produce color variations that match approved Samples.

E. Extend tile work into recesses and under or behind millwork, casework, equipment and fixtures to produce a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

F. Accurately form intersections and returns. Cut and drill tile without marring visible surfaces. Grind cut edges of tile abutting trim, finish, or built-in items to produce straight aligned joints. Fit tile to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

G. Jointing Pattern: Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths.
   1. Lay tile in grid pattern.

H. Joint Widths: Produce uniform joint widths as follows:
   1. Wall Tile: Per manufacturer's recommendations

I. Refer to TCA's "Handbook for Ceramic Tile Installation" and to ANSI A108 Series of tile installation standards for data on expansion joints. Both the "Handbook" and standards require joints to be shown on Drawings. Descriptive specifications are not an adequate substitute for showing joints on Drawings.

J. Expansion Joints: Form expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Locate joints in tile surfaces directly above joints in concrete substrates.
   2. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."

3.08 TRENCH DRAIN INSTALLATION

A. Install the trench drain per manufacturer's written instructions.

B. The channel body shall be set and connected to the waste line simultaneously.
   1. Dry fit the components. Measure and cut a section of pipe to connect the coupling to the odor trap using the channel support as a spacer.
   2. Apply manufacturer's unmodified thin-set moratr to the top of the channel support with a notched trowel and press the channel support firmly onto the underside of the channel body. Attach the mechanical coupling to the drain outlet and the cut section of the pipe per the coupling manufacturer's instructions.
   3. Apply manufacturer's unmodified thin-set mortar to the substrate where the drain is to be placed with a notched trowel. Prepare the cut section of pipe and odor trap with cleaner, primer and ABC or PVC cement per the solvent cement manufacturer's instructions.
   4. Solidly embed the channel support and the trench drain into the mortar on the floor and connect the cut section of pipe to the odor trap. Check to make sure the trench drain is level.
   5. Place the screed flush with the top of the bonding flange of the trench drain. Slope the mortar bed using the bonding flange and the mortar screeds as guides.
   6. Perform leak test on the connection between the drain and waste line prior to continuing with the remainder of the installation.

C. Waterproofing membranes can be installed as soon as the mortar bed is set and able to be walked on.
   1. Install waterproofing membrane up to the outer edge of the trench drain bonding flange using manufacturer's unmodified thin-set mortar mixed per manufacturer's instructions to a fairly fluid consistency but still able to hold a notch.
   2. Apply manufacturer's unmodified thin-set mortar to the mortar bed surrounding the trench drain with a 1/4" x 3/16" V-notched trowel or manufacturer's recommended trowel. Embed waterproofing membrane in the bond coat with the flat side of the trowel to ensure full coverage and remove air pockets.
   3. Apply manufacturer's unmodified thin-set mortar to the membrane surrounding the trench drain with a 1/4" x 3/16" V-notched trowel or manufacturer's recommended trowel. Embed the waterproofing membrane collar in the bond coat to ensure full coverage and remove air pockets.

D. Install the grate per manufacturer's written instructions.
   1. Apply manufacturer's unmodified thin-set mortar to the underside of the grate frame and place it in the channel body ensuring full coverage and support of the frame. Insert the foam spacers in the grate frame to reinforce it during the remainder of installation.
   2. Slide the plastic height adjustment spacers with threaded bolts onto the tabs along the inside of the grate frame to adjust the elevation of the frame. The elevation should be set such that the frame will be flush with the tile covering.
   3. Install manufacturer's unmodified thin-set mortar to the substrate and install the tiles ensuring full coverage. Once the tile covering is set and grouted, remove the spacers from the grate frame and insert the grate.
   4. Protect the visible surfaces of the grate frame and grate from contact with setting and grouting materials. Setting and grouting materials must be removed immediately.

3.09 CLEANING AND PROTECTION

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
   3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven (7) days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.10 FLOOR TILE INSTALLATION SCHEDULE

A. Interior slab-on-grade floor installation on a waterproof memebrane over concrete; thin-set Latex-Portlant cement mortar; TCA F113 and ANSI A108.5 and ANSI A108.17 (where applicable).
   1. Tile Type: As indicated in the Drawing "FINISH KEY".
   2. Thin-Set Mortar: Latex-Portland cement mortar.
   3. Medium Thin-set Mortar for Large Format Tiles: Mortar indicated or manufacturer's recommended mortar.
   4. Location: For all slab-on-grade locations except as otherwise noted.

3.11 WALL TILE INSTALLATION SCHEDULE

A. Tile Installation: Interior wall installation over backer board; thin-set mortar; W244C (wet conditions) with cementitious backer board and waterproof membrane; W243 (dry conditions) with Type X gypsum board; ANSI A108.5.
   1. Tile Type: As indicated in the Drawing "FINISH KEY".
   2. Thin-Set Mortar: Latex-Portland cement mortar or according to manufacturer's recommendation.
   3. Medium Thin-Set Mortar for Large Format Tiles: Mortar indicated or manufacturer's recommended mortar.

END OF SECTION

SECTION 09 5100 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 RELATED REQUIREMENTS

A. Section 07 2100 - Thermal Insulation: Acoustical insulation.

1.03 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.

C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.

D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Provide data on suspension system components.

C. Samples: Submit two samples 6 by 6 inch (152 by 152 mm) minimum in size illustrating material and finish of acoustical units.

D. Manufacturer's Installation Instructions: Indicate special procedures.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 2 percent of total installed for each tile and grid type.

1.05 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Fire-Performance: Provide acoustical panels with surface burning characteristics specified below, based on ASTM E 84 tests performed by UL or other independent agency acceptable to authorities having jurisdiction. Identify packaged products with approval markings of test agency.
   1. Flame Spread: 25 or less.
   2. Smoke Developed: 50 or less.

D. Coordination: Coordinate layout and installation of ceiling system with related construction.

1.06 FIELD CONDITIONS

A. Installation Conditions: Do not install acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and temperature and humidity will be continuously maintained near levels intended for final occupancy.

B. Fireproofing: All fireproofing which is removed shall be replaced. All penetrations of fireproofing shall be patched or sealed to restore the required fire resistance.

C. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.07 DELIVERY, STORAGE AND HANDELING

A. Delivery and Storage:
   1. Deliver ceiling components to project site in original packages and protect during storage against damage.
   2. Before installing acoustical ceiling units, permit them to reach stabilized temperature and humidity of space where they will be installed.

B. Handling: Handle ceiling components to avoid chipping or damaging them.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

A. Acceptable Manufacturers: Acoustical ceiling systems are based on the products of manufacturers listed below and as indicated in the Drawing Finish Key.
   1. Armstrong Commercial Ceilings

B. Substitutions: Subject to compliance with requirements, products of the following manufacturers may be substituted for prior approval upon matching Architect's control sample in color, texture, construction and performance characteristics. Final approval to be determined by Architect.
   1. USG Ceiling Systems, Inc.
   2. Armstrong Commercial Ceilings
   3. CertainTeed

C. Suspension Systems for Acoustical Ceiling Systems:
   1. Basis of Design (**AC-1, AC-2, AC-3, AC-4**): USG Ceiling Systems, Inc. - Donn DX/DXL - 15/16", White.
   2. USG Ceiling Systems, Inc.

D. Ceiling Tiles for Acoustical Ceiling Systems:
   1. **AC-1**:
      a. Basis of Design: USG Ceiling Systems, Inc. - Mars High NRC Panels (SQ) #88137, 2' x 2' x 1", White.
         1) NRC: 0.90
         2) CAC: 30
         3) Light Reflectance: 0.90
         4) Fire Rating: Class A
      b. Armstrong Commercial Ceilings
   2. **AC-2**:
      a. Basis of Design: USG Ceiling Systems, Inc. - Mars High NRC Planks (SQ) #89674, 2' x 6' x 14", White
         1) NRC: 0.90
         2) CAC: 30
         3) Light Reflectance: 0.90
         4) Fire Rating: Class A
      b. Armstrong Commercial Ceilings
   3. **AC-3:**
      a. Basis of Design: USG Ceiling Systems, Inc. - Halcyon ClimaPlus High NRC / CAC #98481, 4' x 8' x 1", White
         1) NRC: 0.95
         2) CAC: 30
         3) Light Reflectance: 0.90
         4) Fire Rating: Class A
      b. Armstrong Commercial Ceilings
   4. **AC-4:**
      a. Basis of Design: USG Ceiling Systems, Inc. - Cleanroom Class 100 (ISO 5) Panels (SQ) Unperforated #56099, 2' x 2' x 5/8", White. Provide Sealant between Tile and Ceiling Grid, Install Hold Down Clips on All Panels

1) NRC: N/A
2) CAC: 35
3) Light Reflectance: 0.79
4) Fire Rating: Class A

b. Armstrong Commercial Ceilings

2.02 ACOUSTICAL CEILING UNITS, GENERAL

A. Standard for Acoustical Ceiling Units: Provide manufacturers' standard units that comply with ASTM E 1264 classifications specified.

B. Mounting Method for Measuring NRC: Type E-400 (plenum mounting in which face of test specimen is 15-3/4 inches [400 mm] away from the test surface) per ASTM E 795.

C. Colors and Patterns: Provide products to match appearance characteristics indicated.

2.03 METAL SUSPENSION SYSTEMS, GENERAL

A. Standard for Metal Suspension Systems: Provide manufacturer's standard metal suspension systems that comply with ASTM C 635 requirements as specified.

B. Finishes and Colors: Provide manufacturer's full range of factory-applied finish.

C. Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

D. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.
1. Gage: Provide wire sized so that stress at 3 times hanger design load (ASTM C 635, Table 1, Direct-Hung) will be less than yield stress of wire, but not less than 0.106-inch diameter (12 gage).

E. Edge Moldings and Trim: Manufacturer's standard moldings for edges and penetrations, of types and profiles indicated.
1. Material: Roll-formed, hemmed-edge, galvanized steel.
2. Finish: Provide manufacturer's full range of factory-applied finish to match system components.

2.04 RELATED MATERIALS

A. Concealed Acoustical Sealant: Nondrying, non-hardening, non-skinning, non-staining, non-bleeding, gunnable synthetic rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission, Pecora "BA-98", Tremco "Acoustical Sealant", or similar.

2.05 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.

2.06 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

B. Hold-Down Clips: Manufacturer's standard clips to suit application.

C. Perimeter Moldings: Same material and finish as grid.
1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

D. Expansion Joints: Provide assembly per Manufacturer's Recommendations.
1. Basis of Design to include Wall Molding (Back to Back with Pop Rivet suspended with hanger wire and installed centered between 1" gap at tile and grid.

E. Acoustical Sealant for Perimeter Moldings: Specified in Section 07 9200.

F. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

C. Examine ambient conditions, substrates and construction to which ceiling system attaches or abuts, for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system. Do not proceed with ceiling installation until unsatisfactory conditions have been corrected.

D. Layout: Generally, measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half-size units at borders, and comply with reflected ceiling plans.

E. If drawing dictates specific layout or work point, comply with Drawings.

F. Coordination: Furnish layouts for preset inserts, clips, and other devices for ceiling hangers which are installed as work of other Sections. Supply devices for installation well in advance of time needed.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C 636/C 636M, ASTM E 580/E 580M, and manufacturer's instructions and as supplemented in this section.

B. Arrangement: Arrange acoustical units and orient ceiling suspension grid shown by reflected ceiling plans.

C. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

D. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size. Unless otherwise indicated.

E. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

F. Suspend ceiling hangers from structural components only, not from conduits, pipes, ducts, and other non-structural items. Do not attach hangers to metal deck or permanent metal forms.

G. Install hangers plumb and free from contact with ducts, pipes, conduits or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counters playing, or other effective means.

H. Space hangers not more than 4'-0" o.c. along each supported member unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.

I. Where ducts and other construction interfere with the location of hangers, install supplemental suspension members and hangers in form of trapezes or equivalent devices to support ceiling loads within performance limits established by referenced standards.

J. Secure wire hangers by looping and wire-tying, either directly to in-place construction or to inserts, eye-screws, or other secure, appropriate devices, and so that attachments will not fail due to age, corrosion, or elevated temperatures.

K. Assemble and support suspension grid in accordance with grid manufacturer's instructions. Support grid independently of edge moldings; do not use edge moldings for support.

L. Level suspension system to tolerance of 1/8" in 12'-0".

M. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

N. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

O. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

P. Support fixture loads using supplementary hangers located within 6 inches (150 mm) of each corner, or support components independently.

Q. Do not eccentrically load system or induce rotation of runners.

R. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Screw-attach moldings to substrate at intervals not over 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8” inch in 12' 0". Miter corners accurately and connect securely.
   2. Install in bed of acoustical sealant.
   3. Use longest practical lengths.
   4. Overlap and rivet corners.

S. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch (25 mm) movement. Maintain visual closure.

3.03 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.
   3. Double cut and field paint exposed reveal edges.

G. Where round obstructions occur, provide preformed closures to match perimeter molding.

H. Install hold-down clips on all AC-4 panels.

I. Install hold-down clips on panels within 20 ft (6 m) of an exterior door.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 5426 - SUSPENDED WOOD CEILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section

1.02 SUMMARY

A. Section Includes
   1. Solid Wood and Wood veneer ceiling panels
   2. Exposed grid suspension system
   3. Wire hangers, fasteners, main runners, wall angle moldings and accessories.

1.03 RELATED SECTIONS:

A. Section 09 5100 - Acoustical Ceilings

B. Section 09 5423 - Metal Ceilings

C. Division 23 - HVAC

D. Division 26 - Electrical

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
   2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
   3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
   5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
   6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
   7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
   8. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
   9. ASTM E 1264 Classification for Acoustical Ceiling Products

B. Hardwood Plywood & Veneer Association (HPVA)

C. International Building Code

D. ASHRAE Standard 62 1 2004 Ventilation for Acceptable Indoor Air Quality

E. NFPA 70 National Electrical Code

F. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

G. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components

H. International Code Council-Evaluation Services Report - Seismic Engineer Report
   1. ESR 1308 - Armstrong T-Bar or Dimensional Suspension

I. California Air Resources Board (CARB) compliant

J. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.

B. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part 3, Installation.

C. Samples: Minimum 4-1/4" x 7" x 3/4" samples of specified panel; 8 inch long samples of exposed wall molding and suspension system, including main runner.

D. Shop Drawings: Illustrating the layout and details of the ceilings. Show locations of items that are to be coordinated with, or supported by the ceilings.

E. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

F. All products not conforming to manufacturer's current published values must be removed and dispose. Replace with complying product at the expense of the Contractor performing the work.

1.06 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
   1. Surface Burning Characteristics: As follows, tested by HPVA (Hardwood Plywood and Veneer Association) under the test standard ASTM E-84 tunnel test and complying with ASTM E 1264 for Class A products.
      a. Flame Spread: 25 or less
      b. Smoke Developed: 50 or less

C. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.

D. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, wet work i.e. gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.07 DELIVERY, STORAGE AND HANDLING

A. Store the wood veneer ceiling panels in a dry interior location in their cartons prior to installation to avoid damage. Store the ceiling panel cartons in a flat, horizontal position. Do not remove the protectors between the panels until installation.

B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Do not expose the wood veneer ceiling panels to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.

C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

1.08 PROJECT CONDITIONS

A. Prior to installation, the wood veneer ceiling materials are required to reach room temperature and have stabilized moisture content for a minimum of 72 hours.

B. Do not install the wood veneer panels in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.

C. As interior finish products, the wood veneer panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

1.09 WARRANTY

A. Wood Veneer Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:
   1. Ceiling Panels: Defects in materials or factory workmanship
   2. Grid System: Rusting and manufacturing defects

B. Warranty Period:
   1. Wood veneer panels: One (1) year from date of installation
   2. Grid: Ten (10) years from date of installation

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.10 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
   1. Ceiling Units: Furnish quantity of full-size units equal to 5.0 percent of amount installed.
   2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Ceiling Panels:
   1. Armstrong World Industries, Inc., Basis of Design

B. Suspension Systems:
   1. Armstrong World Industries, Inc., Basis of Design

2.02 WOOD VENEER CEILING UNITS

A. Ceiling Panels Type **LWC-1**:
   1. Surface Texture: Smooth
   2. Composition: Solid Wood (Poplar)
   3. Finish: Antique Oak
   4. Panel Width: 12"
   5. Panel Length Size(s): With 1" reveal panel to panel at length, provide length to avoid splices wherever possible.
      a. 48" (nominal), 47" (actual)
      b. 72" (nominal), 71" (actual)
      c. 96" (nominal), 95" (actual)
   6. Slat Width: 3/4"
      a. 1-3/8” – 4 Slats (2-1/4”) [6324L_S01---], 5 Slats (1-13/20”) [6325L_S01---], 6 Slats (1-1/4”) [6326L_S01---], 8 Slats (3/4”) [6328L_S01---]
      b. 2-1/4” – 4 Slats (2-1/4”) [6324L_S02---], 5 Slats (1-13/20”) [6325L_S02---], 6 Slats (1-1/4”) [6326L_S02---], 8 Slats (3/4”) [6328L_S02---]
      c. 3-1/4” – 3 Slats (3-1/4”) [6323L_S03---], 4 Slats (2-1/4”) [6324L_S03---]
      d. 4-1/4” – 3 Slats (3-1/4”) [6323L_S04---], 4 Slats (2-1/4”) [6324L_S04---]
   7. Slat Width: 1"
      a. 1-3/8” – 3 Slats (3”) [6323L_S05---], 4 Slats (2”) [6324L_S05---], 5 Slats (1-2/5”) [6325L_S05---], 6 Slats (1”) [6326L_S05---]
      b. 2-1/4” – 3 Slats (3”) [6323L_S06---], 4 Slats (2”) [6324L_S06---], 5 Slats (1-2/5”) [6325L_S06---]
      c. 3-1/4” – 3 Slats (3”) [6323L_S07---], 4 Slats (2”) [6324L_S07---]
      d. 4-1/4” – 3 Slats (3”) [6323L_S08---], 4 Slats (2”) [6324L_S08---]
   8. Slat Width: 1 1/4"

a. 1-3/8” – 3 Slats (2-3/4”) [6323L_S09---], 4 Slats (1-3/4”) [6324L_S09---], 5 Slats (1-5/8”) [6325L_S09---]
b. 2-1/4” – 3 Slats (2-3/4”) [6323L_S10---], 4 Slats (1-3/4”) [6324L_S10---], 5 Slats (1-5/8”) [6325L_S10---]
c. 3-1/4” – 3 Slats (2-3/4”) [6323L_S11----], 4 Slats (1-3/4”) [6324L_S11----]
d. 4-1/4” – 3 Slats (2-3/4”) [6323L_S12---]
e. 5-1/4” – 3 Slats (2-3/4”) [6323L_S13---]

9. Flame Spread:
   a. ASTM E1264 Classification Composite Class C - Contractor to provide flame stop coating option.
   b. ASTM E84 HPVA Fire Classification (Fire Class)
10. Dimensional Stability: Standard
11. Basis of Design Product: WOODWORKS Grille - Forte' Solid Ceiling Panles, with Acoustic Fleece as manufactured by Armstrong World Industries

B. Ceiling Accessories (Ceilings) WoodWorks for **LWC-1**:
1. Prelude XL Heavy Duty Suspension System
   a. Color: Black
2. 5823 - BioAcoustic Infill Panel (Black - Matte)
   a. NRC: 0.75
   b. CAC: N/A
3. Provide all necessary accessories including but not limited to unctions, end caps, backer clips, dowel clips, uptight clips, radius clips, adjustable trim clips, ledgers, and hanger wire.
4. Provide extra stain can for touch-ups.

2.03 METAL SUSPENSION SYSTEMS

A. Components:
1. Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
   a. Structural Classification: ASTM C 635 Heavy Duty duty
   b. Color: Tech Black.
   c. Acceptable Product: PRELUDE XL 15/16" Exposed Tee as manufactured by Armstrong World Industries.

B. Attachment Devices:
1. Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Wire for Hangers and Ties:
1. ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

D. Accessories, Edge Moldings and Trim: Provide all accessories, moldings and trims as necessary for installation.
1. 7/8” Wall Molding - item7800BL
2. 4” Solid Wood Trim with 4 Clips – item7146H4L96(Finish Suffix)
3. 6” Solid Wood Trim with 4 Clips – item7146H6L96(Finish Suffix)
4. Replacement Trim Clip – item 5925
5. Adjustable Trim Clip – item 7239
6. Axiom Vector Straight Trim - Recommend in Black 6” and up – AX_STR (Finish)
7. Axiom Vector Curved Trim - Recommend in Black 6” and up – AX_Cur (Finish)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.

B. Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.02 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

B. Ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation. (Remove plastic wrap to allow panels to climatize)

3.03 INSTALLATION

A. The solid wood panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed, and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

B. Install suspension system and panels in compliance with ASTM C636; CISCA Seismic Guidelines; approved construction drawings; with the authorities having jurisdiction; and in accordance with the manufacturer's installation instructions.

C. Install wall moldings at intersection of suspended ceiling and vertical surfaces.

3.04 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 5813 - MONOLITHIC ACOUSTICAL CEILING SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Suspension systems for perforated gypsum interior ceilings and soffits.
   2. Acoustical Insulation for perforated gypsum board ceilings.
   3. Extruded aluminum trim for ceiling height changes and material transitions.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Subcontractor is an experienced Installer, approved and trained by product manufacturer to properly install ceiling system.
   1. Subcontractor shall provide documentation that they are certified installers of the USG Ensemble™ Ceiling System.
   2. Subcontractor shall utilize approved equipment and procedures for proper installation.

B. Source Limitations: The Ensemble Ceiling is to be purchased and installed by a certified single-source provider.

1.05 COORDINATION:

A. Coordinated Shop Drawings Contractor shall submit coordinated shop drawings that clearly indicate the following components for Architect Approval prior to installation. Shop drawings shall include device alignment, dimensions, center lines and indicate the following:
   1. Ceiling devices.
   2. Ceiling framing.
   3. Changes in ceiling height elevation.
   4. Control joints
   5. Life safety devices.
   6. Miscellaneous items located on ceiling.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packaging and store in an enclosed shelter providing protection from damage and exposure to the elements.
   1. Store within temperature limits required by manufacturer.
   2. Store Ensemble™ panels flat.
   3. Comply with manufacturer’s requirements for safety and handling.

B. Discard joint compounds and sealants that cannot be applied within their stated shelf life.

C. Store accessory materials in a location with constant ambient temperatures of 50 to 80 °F (15 to 27 °C). Avoid exposure to sustained temperatures exceeding 125 °F (52 °C).

1.07 FIELD CONDITIONS

A. Install Ensemble system in an indoor environment that is climate controlled.

B. Comply with ASTM C840 requirements for interior drywall installation: Maintain room temperatures at greater than 40 °F (4.4 °C) at least 48 hours before panel installation and greater than 50 °F (10 °C) at least 48 hours before joint treatment or spray-applied finish application, and continuously during and after application.

C. Avoid exposure and protect from excessive, repetitive or continuous moisture before, during and after installation. Eliminate sources of moisture immediately.

D. Adequate ventilation shall be maintained in the working area during installation and curing period.

1.08 WARRANTY

A. Product is furnished as is to the contractor.

B. Reference Division 01 for General Contractor Obligations.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.02 MONOLITHIC SOUND ABSORBING GYPSUM BOARD SYSTEM

A. Sound Absorbing Gypsum Ceiling and Suspension System: ACP-4
   1. Basis of Design: Subject to compliance with project requirements, the design is based on the following: USG Interiors, LLC, “USG ENSEMBLE™ ACOUSTICAL DRYWALL CEILING”.

2.03 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
   1. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.

B. Perforated Gypsum Board suspension system: complies with applicable requirements per ASTM C 645, direct-hung system composed of Index support bars and cross-furring drywall suspension tees that interlock.
   1. Framing System:
      a. Deflection criteria: L/240 per ASTM C635.
      b. Galvanized Steel: G40 double-web tee, hot-dipped galvanized steel.
   2. Framing Members:
      a. Index support bars: ISB 109.
      b. USG Drywall Suspension system main tees: DLGW26.
      c. USG ISB Cross Brace Clip: ISBAC.
   3. Attachment devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements, if applicable.
   4. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
      a. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
      b. Size: Minimum 12 gage per ASTM C636.

2.04 HIGHLY ENGINEERED GYPSUM-BASED PANEL PRODUCT FOR CEILING APPLICATION

A. Highly Engineered Acoustical Gypsum-Based Panel product for Ceiling application.
   1. Perforated non-fire rated gypsum panel with acoustically transparent scrim: complies with ASTM C1396 Non-Type X.
   2. Subject to compliance with project requirements, the base panel is made from the following: USG Corporation, LLC, “USG Sheetrock® Brand EcoSmart FC 30 Ensemble™ Panels 5/8".
   3. UL Type Designation “FC30” (prior to modifications)
   4. ASTM C 1396/C 1396M: 5/8” wallboard, non-type X (prior to modifications).
   5. ASTM E136 Non-combustibility: Meets or exceeds criteria.
   6. ASTM C473:
      a. Core Hardness: Meets or Exceeds 11 (ASTM C473 B)

b. Flexural Strength (lbf).
1) Parallel: Not less than 46.
2) Perpendicular: Not less than 147.
c. Nail Pull Resistance (lbf) ASTM C473 (B): Not less than 87.
7. Thickness: 5/8 inch (12.7 mm).
8. Length: 9'-4" (2845 mm).
9. Widths: 48"(1220 mm).
10. Weight: 1.65-1.75 lbs./sq. ft.
11. Long Edges: Tapered.

2.05 ACOUSTICAL BACKER PANEL

A. Acoustical Backer Panel: USG Interiors, LLC, "USG Ensemble™ High-NRC Backer Panel".
1. Classification: Provide un-faced acoustical panels with the following physical attributes:
a. NRC: Not less than 0.80.
b. CAC: Not less than 44.
c. Edge/Joint Detail: SQ Square.
d. Panel Thickness: 1 inch (25.4 mm).
e. Modular Size: 16 by 48 inches (406 by 1220 mm).
f. Recycled Content: 66%.
2. High Recycled Content Product: Classified as containing greater than 50% total recycled content. Total recycled content is based on product composition of post-consumer and pre- consumer post-industrial recycled content per FTC guidelines.
3. VOC Emissions: Meets CA Specification 01350, CHPS listed for low emitting materials.

2.06 CEILING PANEL JOINT TREATMENT

A. Perforated Gypsum Board Joint Treatment.
1. General: Comply with ASTM C 475/C 475M, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board:
a. USG Sheetrock® Brand Paper Joint Tape.
b. USG Sheetrock® Brand All Purpose Joint Compound
c. USG Sheetrock® Brand Ensemble® Ceiling Compound
2. Application:
a. Joint Compound for Interior Gypsum Board: For each coat, use formulation that complies with USG Ensemble™ Acoustical Monolithic Ceiling System applied on previous and or successive coats.
3. Prefilling:
a. At open joints or beveled panel edges, use USG Sheetrock® Brand Easy Sand setting- type Compound.
4. Embedding and First Coat:
a. For embedding tape, use USG Sheetrock® Brand All Purpose Joint Compound and embed USG Sheetrock® Brand Paper Joint Tape.
5. Finish Coat:
a. For finish coats on joints, fasteners, and trim flanges, as well as all 3 finish coats over joint tape, use USG Sheetrock® Brand Ensemble® Ceiling Compound. Finish to create a final coat equal to a Level 4 finish. DO NOT SKIM COAT OVER PERFORATIONS.

2.07 CEILING PANEL SPRAY-APPLIED FINISH

A. Acoustically Transparent Finish
1. USG Interiors, LLC, "USG Ensemble™ Spray-Applied Finish":
a. Finish: Fine Finish.
b. Color. Custom colors; Sherwin Williams
1) As Indicated In Finish Key or on Reflected Ceiling Plan
2) Location: See reflected ceiling plans.
2. Classification: Provide acrylic based spray-applied finish complying with USG Ensemble™ Spray-Applied Finish.

2.08 ACCESSORIES

A. Gypsum Board Trim Accessories.
   1. Trim Accessories: Galvanized steel sheet per ASTM 1047: Provide manufacturer approved and tested metal trim that is chemically compatible with the specified ceiling system.
      a. USG Sheetrock Brand Metal Trim:
         1) Corner Bead
         2) L Bead
         3) U Bead
         4) USG Sheetrock® Brand Paper Faced Metal Trim.

B. Drywall edge as shown on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, verify that installed building services to not interfere with work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
   1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:
   1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
   2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.03 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install ISB framing and accessories plumb, and true to line, with connections securely fastened.

C. Install drywall suspension grid framing, and blocking to support fixtures, equipment services, demountable partition supports, or similar construction.

D. Install bracing at terminations in assemblies.

E. This product system installation is similar to a conventional drywall installation. However, there are some differences in both materials and methods of installation that make this system unique. Installers should review and follow all directions of this installation instruction guide.

F. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.04 INSTALLING SUSPENSION SYSTEM

A. Determine the finished ceiling height. If the ceiling extends to the sidewalls, screw attach DGWM24 wall angle to the sidewalls at 5/8” above the finished ceiling height. Fasteners must be in the framing members. Attach hanger wires to structure above using the appropriate method. Hanger wires shall be spaced 48” OC max in each direction. Using pliers, bend the

hanger wires at 3-1/16” above the finished ceiling height. This will set the wires at the correct height for suspending the USG Indexed Support Bars.

B. Insert the hanger wires through the utility holes in the Indexed Support Bars. The Indexed Support Bars will run perpendicular to the main tees at 48” OC max. The hanger wires must be within 5 degrees of plumb. Secure the DGLW26 main tees to the indexed support bars by bending the bulb notch gate open and inserting the main tee bulb into the notch. Bend the gate closed with pliers.

C. Space the main tees at 16” OC. If the ceiling extends wall to wall, square up the main tees and screw attach to the DGWM24 wall angle. Near each hanger wire, secure the ISBAC clip to the ISB109 and main tees using framing screws. ISBAC spacing is 48” OC max.

3.05 INSTALLING FIBEROCK END JOINT BACKER PANELS

A. Fiberock End-Joint Backer Panels are used to construct a “floating end-joint”. The perforated Ensemble™ panel end joints will fall between the main tees and be back-blocked by the Fiberock panels. This creates a taper and makes the butt joints easier to finish. Use a 15-1/2” x 48” piece of 5/8” Fiberock and lay it on the back side of the main tees at the perforated panel end-joint locations. Do not screw attach the Fiberock panels to the main tees.

3.06 INSTALLING 1” ENSEMBLE™ HIGH-NRC BACKER PANELS

A. For high NRC system performance, lay the 1” USG Ensemble™ High-NRC Backers (white side up) in the DGLW26 main tees from above. The acoustical backers are 16” x 48” and lay on the back of the flanges of the main tees. Installation is similar to standard lay-in ceiling panels. Do not install high-NRC backer panels where the perforated panel end joints will be located (this will vary depending on the length of the perforated panels). Do not screw attach backer panels to the main tees.

3.07 PERFORATED GYPSUM BOARD INSTALLATION

A. The USG Sheetrock Brand Ensemble™ Panels can be cut like standard Sheetrock wallboard panels using a T square and utility knife. Score the face of the panels at the desired length, making sure to cut completely through the fiberglass face scrim. Snap the panels and then cut completely through the back scrim. No marks can be made in the field of the panels unless they are covered by USG Sheetrock® brand Ensemble™ Ceiling Compound prior to spraying. (I.e. pencil, marker, or similar).

B. Fasten the perforated panels to the main tees at 12” OC using 1-1/4” fine thread bugle head drywall screws. Fasten end-joints to the Fiberock panels at 8” OC with 1-5/8” coarse thread bugle head drywall screws. The fasteners must be in the field of the board, not the perforations. The fastener head should be just below the surface without tearing the fiberglass scrim.

C. A router or keyhole saw can be used to cut penetrations like standard wallboard.

D. Install beads and trims using the same method as standard wallboard. If the ceiling design is a floating island, trim the perimeter using Compasso Elite for Drywall.

3.08 JOINT FINISHING

A. The joints are finished using the USG Sheetrock® Brand All Purpose Joint Compound, Sheetrock® Brand Paper Joint Tape, and USG Sheetrock® Brand Ensemble™ Ceiling Compound. It is imperative to finish the joints as flat and level with the surface of the board as possible. Even slightly hollow or crowned joints will show as imperfections under critical lighting after the finish is applied.

B. Embed joint tape with the All Purpose Joint Compound. This can be done by hand with a joint knife, or a standard bazooka. Wipe excess with a joint knife and allow to dry completely.

C. Spot all fastener heads with USG Sheetrock® Brand Ensemble™ Ceiling Compound using a 1” or 2” joint knife. Keep the compound area small to minimize covering the perforations.

D. After the tape and bed coat is dry, apply the first coat of USG Sheetrock® Brand Ensemble™ Ceiling Compound over the joints. This can be done using hand tools or a 12” box with the blade set flat. Check for flatness with a 20” knife.

E. Apply the first fill coat of ceiling compound to all beads and trims. Apply second coat to fasteners. Allow to dry completely. Sand joints to remove any excess joint compound. A light sanding of the entire surface will help prep for the spray process but avoid over sanding the fiberglass scrim as much as possible. Apply a finish coat to the joints using a 14” offset blade knife (or similar).

F. Apply a finish coat to all beads and trims using the appropriate width joint knife so that the possibility of shadowing is minimized. Apply a third coat to the fasteners if required. Allow to dry completely. Check all joints, beads, and trims for flatness using a 20” wide knife or straight edge.

G. All joints must be filled and leveled with the surface of the board. Crowned joints must be sanded level using a flat sander. It is important to thoroughly check each joint down the entire length for flatness, not just at a few random locations.

3.09 SPRAY-APPLIED FINISH

A. Note: The proper spray equipment must be used to achieve acoustical performance and esthetics.

B. Please contact your local USG Contractor Specialty Representative for specifications of required spray equipment to apply Ensemble™ Spray-Applied Finish.

C. Mask off all areas that need protecting from overspray with plastic sheathing. Use a floor protector as required. Set up the spray machine and compressor using the proper hoses. Set the compressor to 120 psi. On the spray machine, set the material pump regulator at 70-80 psi, and the spray nozzle atomization air to 110 psi.

D. Spray Applied Finish must be thoroughly mixed prior to application. Mix it in the 4.5-gallon container prior to filling the spray machine hopper. Using a 450-rpm electric drill and a high shear paddle mixer, thoroughly blend the finish until it has a smooth, creamy consistency. Up to 20 oz. clean, potable water may be added to achieve the proper spray consistency.

E. Check for proper consistency using the material thickness gauge provided by the spray equipment manufacturer (small steel ball). If the ball sinks completely, the fine finish is ready to spray. If the ball does not sink within 3 seconds, add more water 4 oz. at a time (up to 20 oz.) and mix thoroughly until the ball sinks.

F. Prime sprayer equipment with 5 gallons of clean potable water. With the nozzle air off, cycle water through the hose and spray gun back into the hopper for 30 seconds and then drain out the water out of the hopper. Pour the 5 gallons of mixed finish into the hopper. With the nozzle air still off, cycle the remaining water out of the hose into a separate container. When the spray finish has reached the gun, cycle the spray finish through the hose and gun back into the hopper until it is flowing smoothly through the machine.

G. The Ensemble™ Spray-Applied Finish must be applied in a minimum of four coats to achieve the proper appearance and sound performance. Apply each coat very lightly with 36” minimum gun clearance. Start in one corner and work progressively across the ceiling. Immediately cross hatch. Once the finish is dry to the touch (approx. 20-40 min), use a drywall squeegee to remove excess spray droplets, then recoat using the same technique. Apply successive coats until the desired appearance is achieved and the perforations are no longer visible through the finish.

H. After the final coat, wait 24 hours and then remove any minor irregularities with a soft rubber bladed squeegee trowel.

I. Maintain proper jobsite conditions and wear proper protective equipment (safety goggles, NIOSH- approved respirator, coveralls) while applying the finish.

END OF SECTION

SECTION 09 6500 - RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient sheet flooring.

B. Resilient tile flooring.

C. Luxury vinyl tile flooring.

D. Resilient base.

E. Installation accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

B. Section 07 1616 - Crystalline Waterproofing: Concrete Sealent

1.03 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.

B. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014).

C. ASTM F1700 - Standard Specification for Solid Vinyl Tile; 2013a.

D. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).

E. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2004 (Reapproved 2014).

F. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2011.

G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures, for submittal process.

B. Product Data: Provide data on all specified products and accessories, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate seaming plans and floor patterns. Minimize seams where possible.

D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

E. Verification Samples: Submit two samples, 2 x 2 inch (51 x 51 mm) minimum in size illustrating color and pattern for each resilient flooring product specified.

F. Concrete Testing Standard: Submit a copy of ASTM F710.

G. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.

H. Maintenance Data: Include maintenance procedures, recommended maintenance materials.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Resilient Flooring: Quantity equal to 2 percent of total installed for each resilient flooring type and color.
   3. Extra Wall Base: 20 linear feet (6 linear meters) of each type and color.
   4. Extra Stair Treads: 20 linear feet of each type and color.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

C. Testing Agency Qualifications: Independent firm specializing in performing concrete slab moisture testing and inspections of the type specified in this section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect roll materials from damage by storing on end.

B. Deliver products to Project site in original manufacturer's unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

C. Store products in dry spaces protected from the weather with ambient temperatures maintained between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C).

D. Store the indoor resilient surfacing rolls in an upright position on a smooth flat surface immediately upon delivery to Project.

E. Move products into spaces where they will be installed at least 48 hours in advance of installation.

1.07 QUALITY ASSURANCE

A. Single-Source Responsibility for products: Obtain each type and color of product specified from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

B. Fire Performance characteristics: Provide products with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Cove Base:
    a. Class B rating in ASTME-84, NFPA 255, UL No. 273, ANSI 2.5, UBC No. 42.1 "Tunnel Test" with a smoke density of 150-200.

1.08 FIELD CONDITIONS

A. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).

B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

C. Close spaces to traffic during installation of products specified in this Section.

1.09 SEQUENCING AND SCHEDULING

A. Sequence installing products specified in this Section with other construction to minimize possibility of damage and soiling during remainder of construction period.

1.10 WARRANTY

A. Resilient Sheet Flooring Warranty (SV-1, SV-2, SV-3): Manufacturers standard 15 year commercial warranty that the resilient product will be free from manufacturering defects during the period of this warranty, including delamination, core voids, thickness variation, and dimensional stability defects. The warranty shall cover wear due to normal foot traffic will not wear through the pattern layer of the product

B. Resilient Sheet Flooring Warranty (SV-1, SV-2, SV-3): Manufacturer's standard form in which manufacturer agrees to repair or replace flooring that fails within specified warranty period against failure including material manufacturering defects, surface war and deterioration to the point of wear through, and failure due to substrate moisture exposure not exceeding 90 percent

relative humidity when tested according to ASTM F2170 or 8 pounds moisture vapor emission rate when tested according to ASTM F1869..

1. Warranty Period
    a. For materials: 2 years from date of Substantial Completion
    b. For surface wear: 10 years from date of Substantial Completion.
    c. For moisture vapor tolerance: 1 year from date of Substantial Completion.
2. Material warranty must be direct from the product manufacturer.
    a. Material warranties from separate or third party insurance providers are not valid
    b. Material warranties from private label distributors are not valid.
3. Special Limited Warranty: Installer's standard form in which installer agrees to repair or replace flooring that fails due to poor workmanship or faulty installation within two years from the date of Substantial Completion.

C. VCT-1 Warranty: Manufacturers standard 5 year commercial warranty that the resilient product will be free from manufacturering defects during the period of this warranty, including delamination, core voids, thickness variation, and dimensional stability defects. The warranty shall cover wear due to normal foot traffic will not wear through the pattern layer of the product.

D. LVT-1 Warranty: Manufacturers standard 20 year commercial warranty that the resilient product will be free from manufacturering defects during the period of this warranty, including delamination, core voids, thickness variation, and dimensional stability defects. The warranty shall cover wear due to normal foot traffic will not wear through the pattern layer of the product.

E. LVT-2 Warranty: Manufacturers standard 15 year commercial warranty that the resilient product will be free from manufacturering defects during the period of this warranty, including delamination, core voids, thickness variation, and dimensional stability defects. The warranty shall cover wear due to normal foot traffic will not wear through the pattern layer of the product.

F. Rubber Base Warranty: Manufacturer's standard 5 year commercial warranty for manufacturing defects.

PART 2 PRODUCTS

2.01 SHEET FLOORING

A. Vinyl Sheet Flooring **(SV-1, SV-2, SV-3)**: Homogeneous without backing, with color and pattern throughout full thickness.

1. Manufacturers: Basis of Design Product (SV-1, SV-2, SV-3): Subject to compliance with requirements, provide the products listed in the Drawing Finish Key. Specific luxury vinyl tiles are identified in the drawings to establish the color, design intent, and required standard of quality. It is not the intent to preclude the use of other prior approved, acceptable manufacturers.
    a. Shaw Contract: www.shawflooring.com
    b. Armstrong Flooring, Inc; _____: www.armstrongflooring.com/.
    c. Gerflor USA, Inc; _____: www.gerflorusa.com.
    d. Or Prior Approved Equal.
2. Minimum Requirements: Comply with ASTM F1913.
3. Finish: ExoGuard
4. Thickness: 0.080 inch (2.0 mm) nominal.
5. Sheet Width: 6.56 ft (2 m)
6. Weight per Roll: 286.6 lbs
7. Maximum Static Load: 2,000 psi max.
8. Coefficient of Friction (ASTM D2047 and ASTM C1028) shall meet ADA requirements, Greater than of Equal to 0.5.
9. Residual Indentation (ASTM F1914): Passes
10. Flexibility (ASTM F137): Passes
11. Resistance to Heat (ASTM F1514): Passes
12. Resistance to Light (ASTM F1515): Passes
13. Resistance to Chemicals (ASTM F925): Passes
14. Smoke Density (aSTM E662, Flaming Mode): Passes

15. Fire Rating Class 1
16. Seams: Heat welded.
17. Adhesive Method:
    a. Full-spread adhesive to completely adhere flooring to substrate.
    b. Complete adhesive coverage to eliminate the possibility of gaps or space between the slab and flooring material where moisture could accumulate and create an environment conducive to mold growth.
    c. Flooring to be adhered to the concrete slab in all locations eliminating the possibility of waves or wrinkles forming caused by the floor shifting, moving or by rolling loads displacing it
18. Color: As indicated on drawings.
19. Surface Treatment/Maintenance: No wax for life.
20. Install matching heat weld. Install cove cap and cove stick on flash cove base.

B. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.

2.02 TILE FLOORING

A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness, and:
1. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
2. Static Coefficient of Friction (ASTM D2047): Greater than of Equal to 0.5 SCOF
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
4. Resistance to Heat ASTM F1514: Delta E less than or Equal to 8
5. Impact Resistance (ASTM F1265): Passes
6. Dimensional Stability (ASTM F2199): Passes
7. Chemical Resistance (ASTM F925): Passes
8. Residual Indentation (ASTM F1914): Conforms
9. Static Load Limit (ASTM F970): Passes 150psi
10. Flammability (ASTM E648): Class 1
11. Size: 12 x 12 inch (305 x 305 mm), unless otherwise indicated.
12. Thickness: 0.125 inch (3.2 mm).
13. Weight: 1.4 lbs./sq. ft.
14. Color: To be selected by Architect from manufacturer's full range.
15. Manufacturers (**VCT-1**):
    a. Basis of Design Product: Subject to compliance with requirements, provide the products listed in the Drawing Finish Key. Specific vinyl tiles are identified in the drawings to establish the color, design intent, and required standard of quality. It is not the intent to preclude the use of other prior approved, acceptable manufacturers.
    b. Armstrong World Industries; Product - Imperial Texture Standard Excelon.
    c. Tarkett; Product: VCT II
    d. Or prior approved equal.

B. Luxury Vinyl Tile **(LVT-1)**: Solid vinyl with color and pattern throughout thickness, and:
1. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
2. Slip Resistance ASTM D2047: ADA Compliant; Greater than or Equal to 0.5 SCOF
3. Static Load Limit ASTM F970: 250 psi; <0.005"
4. Residual Indentation (ASTM F1914): passes, 8%
5. Resistance to Heat ASTM F1514: Delta E less than or Equal to 8
6. Resistance to Light ASTM F1515: Delta E less than or Equal to 8
7. Resistance to Chemicals (ASTM F925): Passes
8. Flammability (ASTM E648, CRF) Greater Than or Equal to 0.45 W/ sq. cm (Class 1)
9. Dimensional Stability (ASTM F2199): Passes
10. Plank Tile Size: 6 by 48 inch (152 by 1219 mm).

11. Edge Treatment: Square
12. Wear Layer Thickness: 0.020 inch (0.5 mm).
13. Total Thickness: 0.120" inch (3.0 mm), unless otherwise indicated in Drawings.
14. Finish: Techtonic
15. Pattern: As Indicated in Drawings.
16. Installation: Glue Down
17. Manufacturers:
    a. Basis of Design Product (**LVT-1**): Subject to compliance with requirements, provide the products listed in the Drawing Finish Key. Specific luxury vinyl tiles are identified in the drawings to establish the color, design intent, and required standard of quality. It is not the intent to preclude the use of other prior approved, acceptable manufacturers.
    b. Basis of Design Product: Tarkett ID Latitude Wood
    c. Shaw Contract
    d. Interface
    e. Patcraft
    f. Mannington
    g. Or prior approved equal.

C. Luxury Vinyl Tile **(LVT-2)**: Solid vinyl with color and pattern throughout thickness, and:
1. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
2. Slip Resistance ASTM D2047: ADA Compliant
3. Coefficient of Friction (ASTM D2047, Slip Resistance): > 0.6, meets the recommended static coefficient of friction for ADA surfaces and accessible routes.
4. Static Load Limit ASTM F970: Passes
5. Residual Indentation (ASTM F1914): Passes
6. Resistance to Heat ASTM F1514: Passes
7. Resistance to Light ASTM F1515: Passes
8. Resistance to Chemicals (ASTM F925): Passes
9. Radiant Flux ASTM E648: Passes, Class 1
10. Smoke Density ASTM E662: Passes
11. Dimensional Stability (ASTM F2199): Passes
12. Size: 12 x 24 inch (304 x 609 mm) long plank unless otherwise indicated in Drawings.
13. Edge Treatment: Square
14. Wear Layer Thickness: 0.020 inch (0.5 mm).
15. Total Thickness: 0.098" inch (2.5 mm), unless otherwise indicated in Drawings.
16. Finish: Techtonic
17. Pattern: As Indicated in Drawings.
18. Installation: Glue Down
19. Manufacturers:
    a. Basis of Design Product (**LVT-2**): Subject to compliance with requirements, provide the products listed in the Drawing Finish Key. Specific luxury vinyl tiles are identified in the drawings to establish the color, design intent, and required standard of quality. It is not the intent to preclude the use of other prior approved, acceptable manufacturers.
    b. Basis of Design Product: Shaw Intricate
    c. Shaw Contract
    d. Interface
    e. Patcraft
    f. Mannington
    g. Or prior approved equal.

2.03 RESILIENT BASE

A. Resilient Base (**RB-1**): ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
   1. Height: 4.25 inch
   2. Thickness: 0.25 inch
   3. Length: 8 foot (2.4 m) sections.
   4. Inside and Outside Corners NOT ALLOWED.
   5. Color: As Indicated in drawings, or as selected by Architect from manufacturer's full range.
   6. Manufacturers (**RB-1**):
      a. Basis of Design: Johnsonite, a Tarkett Company, Product - Millwork Reveal Profile Base: www.johnsonite.com
      b. Burke Flooring: www.burkemercer.com.
      c. Roppe Corp; _____: www.roppe.com.

B. Resilient Base (**RB-2**): ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
   1. Height: 4 inch (100 mm).
   2. Thickness: 0.125 inch (3.2 mm).
   3. Length: Roll.
   4. Thickness 1/8"
   5. Inside and Outside Corners NOT ALLOWED.
   6. Color: As Indicated in drawings, or as selected by Architect from manufacturer's full range.
   7. Manufacturers (**RB-2**):
      a. Johnsonite, a Tarkett Company, Product - Traditional Cove Base: www.johnsonite.com
      b. Burke Flooring: www.burkemercer.com.
      c. Roppe Corp; _____: www.roppe.com.

2.04 ACCESSORIES

A. Primers, and Seaming Materials: Waterproof; types recommended by flooring manufacturer, and coordinated with Specification Section Crystalline Waterproofing
   1. LVT Primer: Manufacturer's Recommended product

B. Adhesives: Bases other than concrete: Water-resistant type recommended by manufacturer to suit resilient flooring product and substrate conditions indicated.

C. Weld Rod: As supplied by flooring manufacturer. Color shall blend with resilient flooring color.
   1. Heat

D. Sealer and Wax: Types recommended by flooring manufacturer.
   1. Minimum Number of Wax Coats: As recommended by Manufacturer for floors intended purpose.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
   1. Concrete floors shall be flat and smooth within 1/8” in 6 feet or 3/16” in 10 feet

B. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
   1. Test as Follows:
      a. Internal Relative Humidity: ASTM F2170.
   2. Concrete substrates to receive LVT shall not exceed 90% RH. The PH of the concrete must be between 7 and 10.
   3. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

C. Other work, including overhead work, that could cause damage, dirt, dust or otherwise interrupt installation has been completed or suspended.

D. No foreign materials or objects are present on the substrate and that it is clean and ready for preparation and installation.

E. The concrete slab surface deviation is no greater than 3/16 inch within 10 feet (4.5 mm within 3 m) as described in AC1117R.

F. The concrete slab complies with ACI 302.2R for concrete design including use of a low-permeance vapor barrier directly beneath the concrete subfloor with sealed penetrations

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Clean substrate.

C. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

D. Use trowelable concrete based leveling and patching compound with the same moisture vapor tolerance as the adhesive to fill depressions, holes, cracks, grooves or other irregularities in substrate.

E. Sand the surface of the concrete slab.

F. Sweep and then vacuum substrates immediately before installation. After cleaning, examine substrate for moisture, alkaline salts, grit, dust or other contamination. Proceed with installation only after unsatisfactory conditions have been corrected

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Fit joints and butt seams tightly.

3.04 INSTALLATION - SHEET FLOORING

A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

B. Fit flooring neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

D. Adhered Flooring: Attach products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturer instructions

E. Seal seams by heat welding where indicated. Finish seams to produce surfaces flush with adjoining flooring surfaces. Comply with ASTM F 1516. Rout joints and use heat welding rod to permanently and seamlessly fuse sections together.

3.05 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

C. Install plank tile with a random offset of at least 6 inches (152 mm) from adjacent rows.

D. LVT Installation:
   1. Install using conventional tile and plank installation techniques. Plank products should have a minimum of 6 to 8” seam stagger.
   2. Center rooms and hallways so borders are not less than half of a tile or plank.

3. Work out of multiple boxes at the same time.
4. In hallways and small spaces, work lengthwise from one end.
5. Ensure cut edges are always against the wall.
6. To cut products, score the top side of the material with a utility knife. Bend the product and finish the cut through the back side. It may be necessary to use a heat gun to cut around vertical obstructions. Allow the heated product to return to room temperature before installation.
7. If you cut the product into a fine point, it may delaminate. Use an ethyl cyanoacrylate-based super glue to fuse the points together. Clean all glue from the top surface immediately. Alcohol-based super glues may cause the vinyl to swell.
8. Roll the plank or tile with a 3-section 100 lb. roller. Re-roll the floor within the working time of the adhesive. Continue to roll the floor throughout the working day to ensure a proper bond.
9. Use floor protection after installation. DO NOT use a plastic adhesive-based protection system

3.06 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.

C. Scribe and fit to door frames and other interruptions.

3.07 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

C. LVT Initial Maintenance:
1. Sweep, vacuum or dust mop to remove dirt and grit.
2. If needed, add neutral cleaner to cool water following the manufacturer’s instructions.
3. Scrub with a low-rpm machine or auto scrubber. Use a red pad or brush.
4. Never use brown or black pads (too aggressive and can damage the product)
5. Remove the cleaning solution with a wet-dry vacuum or auto scrubber until the floor is dry.
6. Rinse the floor with clean water. Repeat the rinse process if necessary to remove all haze

D. LVT Routine Maintenance
1. Sweep, vacuum or dust mop to remove dirt and grit.
2. Add neutral pH cleaner to cool water following the manufacturer’s instructions.
3. As needed, scrub with a low-rpm machine or auto scrubber to retain appearance. Use a red (light scrubbing) pad and neutral cleaner following the manufacturer’s instructions

E. Sheet Vinyl Flooring :
1. Remove marks and blemishes from flooring surfaces.
2. Sweep and then vacuum flooring.
3. Damp-mop flooring to remove soiling.
4. Protect flooring from abrasions, indentations, and other damage from subsequent operations and placement of equipment, during remainder of construction period.

3.08 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

B. LVT Preventative Floor Care:
1. Use walk-off mats that are as wide as the doorway and long enough for soil load and weather conditions.
2. Use mats with a non-staining backing.
3. Floor protectors should be used on all furniture legs.
4. The surface area of the floor protectors should be no less than 1” in diameter
5. It shall be the responsibility of the party specifying and procuring the furniture, whether temporary during construction or for permanent installation in the building, to ensure that

the proper floor protectors are specified and installed on all furniture, chairs, fixtures, etc. that will be in contact with LVT flooring. Upon taking possession of the building, the Owner shall be responsible for maintaining floor proection on all furniture and communicating protective measures for items to be placed on LVT flooring to avoid scratching and gouging of flooring wear layer surface.

C. VCT Preventative Floor Care:
   1. Clean floor thoroughly of any loose dust, grit, and debris. Remove any dried adhesive residue with a clean, white cloth dampened with mineral spirits, carefully following the warnings on the container. Damp mop the floor with a properly diluted neutral (ph 6 to 8) detergent solution.
   2. Protect all doors, millwork, and adjacent surfaces in preparation for wax installation. Contractor will be responsible for removal of wax from these surfaces and any damage that results.
   3. Install a minimum of two wax coats per the manufacturer's written instructions on all vinyl composition flooring immediately after installation of the flooring to temporarily protect the floor until regular maintenance procedures can begin. Ensure that areas being waxed are blocked off from traffic until wax has cured per manufacturer's written instruction.
   4. Machine scrub the floor with a properly diluted neutral detergent solution and a scrubbing pad or equivalent brushes as recommended by the manufacturer. Do not use pads more abrasive than manufacturer recommends as this can damage the floor finish. If the floor is badly soiled and/or scratched, strip it using the same procedure but substituting a properly diluted sripping solution. The use of aggressive stippers such as a mop-on/mop-off, no-scrub and no-rincse strippers shall not be permitted.
   5. Thoroughly rinse the entire floor with fresh clean water. Remove rinse water and allow the floor to dry completely.
   6. Apply a additional wax coats (for a total minimum of five coats) of high quality commercial floor polish. If the floor has been stripped, the application of a stain resistant sealer prior to the application of polish is required in areas exposed to heavy traffic or staining agents.

END OF SECTION

SECTION 09 6623 - RESINOUS MATRIX TERRAZZO FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Epoxy matrix terrazzo with ground and polished finish.

B. Divider strips.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete subfloor with steel trowel finish.

B. Section 07 9200 - Joint Sealants: Sealing joints between terrazzo work and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

A. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.

B. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2011.

C. NTMA (EPOXY) - Epoxy Terrazzo Specifications; The National Terrazzo and Mosaic Association, Inc; Current Edition located at www.ntma.com.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Provide data for divider strips, control joint strips, expansion joints, and sealer; include printed copy of current NTMA recommendations for type of terrazzo specified.

C. Shop Drawings: Indicate divider strip and control and expansion joint layout, and details of adjacent components. For precast units, detail profile and anchorage requirements.

D. Samples: Submit two samples, 12 inch (___ mm) by 12 inch (___ mm) in size illustrating color, chip size and variation, chip gradation, matrix color, and typical divider strip.

E. Manufacturer's Installation Instructions: Indicate special procedures.

F. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

G. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.

H. Cleaning and Maintenance Data: Include procedures for stain removal, stripping, and sealing.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with NTMA recommendations as posted at their web site at www.ntma.com.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section.

1. Submit at least five (5) epoxy terrazzo projects using material being submitted for project. Jobs must be similar scope, size and complexity.
2. Engage an installer who is certified in writing by terrazzo manufacturer as qualifed to install manufacturer's products.

C. Source Limitations: Obtain primary terrazzo materials from single source manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

D. Source Limitations for Marble Chips: Obtain each color, grade, type and variety of granular materials from one source with resources to provide materials of consistent quality in appearance and physical properties.

E. Testing Agency Qualifications: Independent firm specializing in performing concrete slab moisture testing and inspections of the type specified in this section.

F. Testing and Moisture Mitigation Requirements: Flooring Sub-Contractor and/or Flooring Manufacturer shall be responsible for engaging testing agency to perform concrete slab moisture testing. Testing report shall be provided to the Flooring Manufacturer, Owner and Architect for their records. Flooring Sub-Contractor shall be responsible for the cost of all testing and responsible for the cost and installation of all mitigation measures and adhesive as required to meet Flooring Manufacturer's requirements to provide full flooring assembly warranty. The Flooring Manufacturer shall provide a letter to the Contractor, Flooring Sub-Contractor, Owner and Architect prior to proceeding with installation stating the requirements for moisture mitigation (should any be required by the results of the concrete slab moisture testing), and adhesive product and application requirements. The Flooring Manufacturer shall have a representative verify that required moisture mitigation has been performed prior to installation.

1.06 MOCK-UP

A. Construct mock-up of terrazzo illustrating appearance of finished work in each configuration required. Size mock-up to be not less than 3 by 3 feet (1 by 1 m).

B. Locate where directed.

C. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to Project site in supplier's original wrappings and containers, labeled with source or manufacturer's name, material or product brand name and lot number if any.

B. Materials shall be stored in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures and humidity.

1.08 FIELD CONDITIONS

A. Environmental Limitrations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.

B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.

C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.

D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.

E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

1. Provide dustproof partitions and temporary enclosures to limit dust migration and to isolate areas from noise.

1.09 WARRANTY

A. Manufacturer's Warranty: The Manufacturer shall warrant for a period of one (1) year that the resin will be free of manufacturing defects and will conform to published specification when handled, stored, mixed and applied in accordance to recommendations of the manufacturer.

B. Flooring Adhesion Warranty: Provide Manufacturer's Standard Warranty for Adhesive Product to be free from manufacturering defects for a minimum of one year. The duration of the bond warranty shall be equal to the flooring warranty period per product.

PART 2 PRODUCTS

2.01 PERFORMANCE

A. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Epoxy Resin:
   1. Test Specimens: Mix resin materials according to manufacturer's recommendation without aggregate added and cure for 7 days at 75 degrees plus or minus 2 deg. F and 50 percent plus/minus 2 percent relative humidity.
   2. Cured test specimens shall meet or exceed the following requirements:
      a. Hardness: 60 to 85 per ASTM D 2240, Shore D.
      b. Minimum Tensile Strength: 3000 psi per ASTM D 638 for a 2-inch specimen made using a "C" die per ASTM D 412.
      c. Minimum Compressive Strength: 10,000 psi per ASTM D 695, Specimen B cylinder.
      d. Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
         1) Distilled Water.
         2) Mineral Water.
         3) Isopropanol.
         4) Ethanol.
         5) Soap solution at 1 percent.
         6) Sodium hydroxide at 10 percent solution.
         7) Hydrochloric acid at 10 percent solution.
         8) Hydrochloric acid at 30 percent solution.
         9) Detergent Solution at 0.025.
         10) Acetic Acid at 5 percent solution.

C. Epoxy Resin with Aggregate:
   1. Test Specimens:
      a. Mix epoxy resin according to manufacturer's recommendations and blend one volume of epoxy resin with 3 volumes of marble aggregate, consisting of:
         1) 60 percent No. 1 chip.
         2) 40 percent No. 0 chip.
      b. Grind and grout with epoxy resin finished to a nominal 1/4 inch thickness.
      c. Cure specimens 7 days at 75 deg. F plus/minus 2 deg. and 50 percent plus/minus 2 percent relative humidity.
   2. Cured epoxy terrazzo specimens shall nominally meet the following requirements:
      a. Flammability: Self-extinguishing, extent of burning 1/4 inch maximum according to ASTM D 635.
      b. Coefficient of Linear Thermal Expansion: 0.0025 inch/inch per deg F for temperature range of minus 12 to plus 140 deg F per ASTM D 696.

D. Bond Strength of Epoxy Terrazzo: 300 lb. failure according to field test method for surface soundness and adhesion as described in ACI Committee No. 403 Bulletin.

2.02 MANUFACTURERS

A. Basis of Design Product **(TZ-1)**: Subject to compliance with requirements, provide terrazzo system from Venable Terrazzo Company, or a comparable product by one of the following:
   1. Basis of Design: Terrazzo Masters Epoxy Resin with Aggregate
      a. Epoxy Resin: #2001 White
      b. Formula: 60% China White #1, 30% Georgian White #1, 10% Mother of Pearl, #2
   2. Terrazzo & Marble Supply Companies; Terroxy Resin Systems.
   3. Or prior approved equal.

2.03 EPOXY MATRIX TERRAZZO APPLICATIONS

A. Floors:
   1. Thickness: 3/8 inch (9 mm), nominal.
   2. Color(s): As indicated on drawings. or to be selected by Architect from manufacturer's full range, if not indicated.
   3. Aggregate Type: Marble chips.
   4. Aggregate Size: No. 1 & No. 2 as Indicated in Basis of Design Formula.
   5. Strip Layout per Drawings.

2.04 MATERIALS

A. Marble Chips: Sizes conforming to NTMA gradation standards for mix indicated, with Ha 10 minimum abrasive-hardness value when tested according to ASTM C 241, 0.75 percent maximum 24-hour absorption rate, dust content of less than 1 percent by weight, and containing no deleterious or foreign matter.

B. Epoxy-Resin Matrix: Provide matrix complying with NTMA's "Guide Specification for Epoxy Terrazzo" in color required for mix indicated.

C. Heavy-Top Divider Strips: Straight or angle type as required by terrazzo type indicated, with anchoring device, in depth required for topping thickness indicated, and as follows:
   1. Bottom-Section Material: Matching top-section material.
   2. Top-Section Material: White zinc alloy.
   3. Top-Section Width: 1/8 inch.

D. Control-Joint Strips: Separate, double L-type angle or straight strips positioned back-to-back matching material, thickness, and color of divider strips in depth required for topping thickness indicated.

E. Accessory Strips: Match divider-strip width, material, and color, unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
   1. Base bead and base dividers.
   2. Edge beads for exposed edges of terrazzo.

F. Flexible Epoxy Isolation Membrane: Epoxy-resin matrix, manufacturer's 100 percent solids epoxy membrane for crack penetration.

G. Divider-Strip Adhesive: Epoxy-resin adhesive recommended by manufacturer for this use and acceptable to terrazzo manufacturer for priming substrate.

H. Thin-Set Terrazzo Primer: Two-component resin or other compound recommended by thin-set terrazzo resin manufacturer for priming substrate.

I. Thin-Set Terrazzo Finishing Grout: Thin-set terrazzo resin manufacturer's resin-based finishing grout.

J. Cleaner: Chemically neutral cleaner with pH factor between 7 and 12 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.

K. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral with pH factoer between 7 and 12, does not affect color or physical properties of terrazzo type indicated, is recommended by sealer manufacturer for this use, and complies with NTMA Guide Specification for terrazzo type indicated.

L. Finishing Grout: Epoxy, color to match terrazzo matrix.

PART 3 EXECUTION

3.01 EXAMINATION

A. The General Contractor and Architect shall examine substrates and areas, with Terrazzo Contractor present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that concrete surfaces to receive terrazzo flooring are sound, free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil and other contaminants incompatible with terrazzo flooring materials.

B. Terrazzo Contractor shall proceed with installation only after unsatisfactory conditions, including levelness

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for terrazzo flooring installation by testing for moisture and alkalinity (pH).
   1. Test as Follows:
      a. Test in accordance with ASTM F2710 probe/core test.
      b. Internal Relative Humidity: ASTM F2170.
      c. Moisture Vapor Emission: ASTM F1869.
   2. Conduct tests by an independent testing agency acceptable to Owner.
   3. Obtain written instructions from Manufacturer based on test results for any required moisture mitigation and adhesive product/installation requirements. Do not proceed with installation until flooring substrate and mitigation measures, if applicable, have been approved in writing by the flooring manufacturer.

3.02 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo or underbed's bond. Provide clean, dry and neutral substrates for terrazzo application.
   1. Roughen concrete substrates before installing terrazzo or underbed according to NTMA's written recommendation.
   2. Prepare terrazzo substrates according to resin manufacturer's written instructions.
   3. Perform any mitigation required by the manufacturer as a result of concrete slab testing.

B. Protect work from dust generated by grinding operations. Control dust to prevent air pollution and comply with governing environmental protection regulations.
   1. Erect and maintain temporary enclosures and other suitable methods to limit dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

C. Apply primer in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Comply with NTMA Guide Specification for terrazzo type indicated and NTMA's written recommendations for substrate preparation and terrazzo installation.

B. Flexible Epoxy Isolation Membrane: Prepare and prefill substrate cracks with membrane material and install flexible epoxy isolation membrane according to manufacturer's written instructions. Prepare epoxy membrane according to manufacturer's written instructions before applying substrate primer.

C. Prime terrazzo substrates according to resin manufacturer's written instructions.

D. Install divider and accessory strips according to NTMA's written recommendations.

E. Install control-joint strips back-to-back directly above substrate control joints and according to NTMA's written recommendations.

F. Install angle- or T-type strips and similar accessories in adhesive setting bed without voids below strips. Provide mechanical anchorage of strips as required for adequate attachment of strips to substrate.

G. Terrazzo: Place, cure, grind, grout, and finish terrazzo according to resin manufacturer's written instructions and NTMA Guide Specification for terrazzo type indicated. Ensure fluids from grinding operations do not react with divider and control-joint strips and stain marble chips. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.

H. Cut out and replace terrazzo areas that evidence lack of bond with substrate or underbed, including areas that emit a "hollow" sound when tapped. Cut out terrazzo areas in panels

defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.04 FINISHING

A. Finish terrazzo to NTMA requirements.

B. Grind terrazzo surfaces with power disc machine; sequence with coarse to fine grit abrasive, using a wet method or using a dry grinder with vacuum to control dust.

C. Apply grout to fill voids exposed from grinding.

D. Remove grout coat by grinding, using a fine grit abrasive.

3.05 TOLERANCES

A. Maximum Variation from Flat Surface: 1/4 inch in 10 feet (6 mm in one m).

B. Maximum Variation from Level (Except Surfaces Sloping to Drain): 1/8 inch (3 mm).

3.06 CLEANING

A. Remove grinding dust from installation and adjacent areas.

B. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions.

C. Rinse surfaces with water and allow to dry thoroughly.

D. Seal surfaces according to NTMA's written recommendations. Apply sealer according to sealer manufacturer's written instructions.

3.07 PROTECTION

A. Protect finished terrazzo from damage due to subsequent construction until Date of Substantial Completion.

B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure terrazzo is without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 09 6700 - FLUID-APPLIED FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fluid-applied flooring and base.

1.02 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available; and _____.

C. Samples: Submit two samples, 6" by 6" inch (____by____ mm) in size illustrating color and pattern for each floor material for each color specified.

D. Manufacturer's Installation Instructions: Indicate special procedures.

E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing work of this section with minimum five years experience. Installer shall be experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
2. Contractor shall have completed at least 10 projects of similar size and complexity.

C. Supervisor Qualifications: Trained by product manufacturer, under direct full time supervision of manufacturer's own foreman.

D. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

E. Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.

1. Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.

F. Pre-Installation Conference:

1. General contractor shall arrange a meeting not less than thirty days prior to starting work.
2. Attendance shall include but not be limited to the General Contractor, Architect/Owner's Representative, and Manufacturer/Installer's Representative.

1.04 MOCK UP

A. Construct mock-up(s) of fluid applied flooring to serve as basis for evaluation of texture and workmanship.

1. Number of Mock-Ups to be Prepared: One.
2. Use same materials and methods for use in the work.
3. Locate where directed.
4. Minimum Size: 24 x 24 inches (____ mm) with full depth base.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Material shall be delivered to project site in manufacturer's original unopened containers.

B. Materials shall be stored indoors, protected from damage, moisture, direct sunlight and temperatures below 40 degrees F or above 90 degrees F.

C. All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed

D. Do not use drain piping for disposal of coating materials.

E. The Contractor shall take all precautions and implement all measures necessary to avert potential hazards associated with the epoxy flooring system materials as described in the manufacturer's literature or container labels.

F. Labels on all material containers must show the following information:
   1. Name or title of product.
   2. Manufacturer's batch number.
   3. Manufacturer's name.
   4. Generic type of material.
   5. Application and mixing instructions.
   6. Hazardous material identification label.
   7. Shelf life date.

G. All containers shall be clearly marked indicating any personnel safety hazards associated with the use of, or exposure to the materials.

H. All materials shall be handled and stored to prevent damage or loss of label.

I. Do not use or retain contaminated, outdated, prematurely opened, diluted materials, or materials which have exceeded their shelf life.

1.06 FIELD CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
   1. Maintain material and substrate temperature between 65 and 85 deg F (18 and 30 deg C) during resinous flooring application and for not less than 24 hours after application.

B. Store materials in area of installation for minimum period of 24 hours prior to installation.

C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

D. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

E. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

F. Concrete substrate shall be properly cured. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring.

1.07 WARRANTY

A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full years from date of installation, or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Seamless Resinous Flooring(**SF-1**):

1. Basis of Design: Stonhard Stonetec Seamless Resinous Flooring, Color: Sheandoah Buff, with 6" high integral cove base.
2. Tnemec
3. Stonesheild
4. Sherwin Williams
5. Tufco

2.02 RESINOUS FLOORING SYSTEM

A. Product Requirements: System shall include 25mil body coat, and broadcast quartz into primer increasing bond strength.

B. System Characteristics:
1. Color and Pattern: As Indicated in Finish Key
2. Wearing Surface: Standard
3. Integral Cove Base: 6" height
4. Overall System Thickness: 1/8" (2mm)

C. System Components: Manufacturer's standard components that are compatible with each other and as follows:
1. Primer:
a. Material Basis: Stonhard Standard Primer
b. Resin: Epoxy
c. Formulation Description: (2) two component 100 percent solids.
d. Application Method: Squeegee and roller.
e. Number of Coats: (1) one.
f. Aggregates: Broadcast quartz into wet primer coat
2. Body Coat(s):
a. Material Basis: Stonshield Undercoat.
b. Resin: Epoxy.
c. Formulation Description: (3) three component solvent free epoxy.
d. Application Method: Notched squeegee.
1) Thickness of Coats: 25-30 mils with standard primer coat
2) Number of Coats: (1) One.
3. Broadcast:
a. Material Basis: Stontec Flakes
b. Formulation Description: Decorative flake (1/16” or ¼)
c. Type: Tweed (chips to be mixed in Mfg. facility)
d. Finish: Broadcast to rejection.
e. Number of Coats: one
4. Topcoat:
a. Material Basis: Stonkote CE4
b. Resin: Epoxy.
c. Formulation Description: (2) component, UV stable, solvent free epoxy.
d. Type: Clear.
e. Finish: Gloss. (see finish schedule for texture options)
f. Number of Coats: Two

D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated.
1. Tensile Strength: 5,200 psi per ASTM D-638
2. Flexural Strength: 4,000 psi per ASTM D-790
3. Flexural Modulus of Elasticity: 1.7 x 10^6 psi per ASTM D-790
4. Hardness: .85 to .90 per ASTM D-2240, Shore D
5. Linear Coefficient of Thermal Expansion: 17 x 10^-6 in./in. ?F per ASTM C-531
6. Impact Resistance: Exceeds 160 in.-lbs. per ASTM D-4060, CS-17
7. Abrasion Resistance: 0.03 gm max. weight loss per ASTM D-4060, CS-17
8. Flammability: Class I per ASTM E-648

E. Accessory Materials
   1. Patching, Leveling and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated. No Single component or cementitious materials.
   2. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.

C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of materials to sub-floor surfaces.

D. Verify that concrete sub-floor surfaces are ready for flooring installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by flooring materials manufacturer.

E. Verify that required floor-mounted utilities are in correct location.
   1. Mock-up
      a. Prior to commencing the installation, the Contractor shall install with the Owner's approval, a mutually agreed upon mock-up test sample to show final color and appearance of the epoxy flooring system. No work shall continue until the mock-up is approved by Owner or Architect.

3.02 PREPARATION

A. Allow new concrete to cure for 28 days. Verify dryness by testing for moisture with a "plastic film tape-down test". (Reference ASTM D4263).

B. Remove sub-floor ridges and bumps.

C. Mechanically prepare substrates as follows:
   1. Mechanically prepare with the use of Diamond grinding equipment to provide surface sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring. Or,
   2. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup or Diamond Grind with a dust free system.
   3. Comply with ASTM C 811 requirements, unless manufacturer's written instructions are more stringent

D. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations

E. Verify that concrete substrates meet the following requirements.
   1. Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 80 percent.
   2. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab in 24 hours

F. Vacuum clean concrete to remove all dirt, dust, and other loose materials.

G. Fill low spots, cracks, joints, holes, and other defects with material that is verified compatible with the epoxy laminate system.

H. After mechanically abrading, verify that all surfaces are clean, dry and free of any contaminants, which could adversely affect the adhesion of the flooring system.

I. If between final surface preparation work and epoxy flooring system application, contamination of the prepared and cleaned substrates occurs, recleaning shall be required until the requirements of this Section are met.

J. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations. Allowances should be included for Stonflex MP7 joint fill material

3.03 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
   1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
   2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
   3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
      a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Mix and apply primer over properly prepared substrate with strict adherence to manufacturer's installation procedures and coverage rates

C. Broadcast: Immediately broadcast quartz silica aggregate into the primer using manufacturer's specially designed spray caster. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.

D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and top coating of cove base. Round internal and external corners. Refer to detail drawings.

E. Body coat: Mix base material according to manufacturer's recommended procedures. Uniformly spread mixed material over previously primed substrate using manufacturer's installation tool. Roll material with strict adherence to manufacturer's installation procedures and coverage rates.

F. Broadcast: Immediately broadcast decorative flakes into the body coat. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.

G. First Sealer: Remove excess un-bonded flakes by lightly brushing and vacuuming the floor surface. Mix and apply sealer with strict adherence to manufacturer's installation procedures.

H. Second sealer: Lightly sand first sealer coat. Mix and apply second sealer coat with strict adherence to manufacturer's installation procedures.

I. Waterproofing membranes may not require a primer; verify requirements for resinous flooring systems selected

3.04 TERMINATIONS

A. Chase edges to “lock” the coating system into the concrete substrate along lines of termination.

B. Penetration Treatment: Lap and seal coating onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.

C. Trenches: Continue coating system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.

D. Treat floor drains by chasing the coating to lock in place at point of termination

3.05 JOINTS AND CRACKS

A. Treat control joints to bridge potential cracks and to maintain monolithic protection.

B. Treat cold joints and construction joints to and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.

C. Vertical and horizontal contraction and expansion joints are treated by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered

3.06 CLEANING, PROTECTION AND CURING

A. Cure resinous flooring materials in compliance with manufacturer's directions.

B. Protect the completed work from water, airborne particles or other surface contaminants until cured for a minimum of 24 hours after application.

C. Protect from traffic, physical abuse, immersion and chemical exposure until the complete system has thoroughly cured for 24 hours at 75 degrees F. For different temperatures, consult the manufacturer's representative about curing times.

D. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection.

E. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer. General Contractor is responsible for cleaning prior to inspection

3.07 FIELD QUALITY CONTROL INSPECTION AND TESTING

A. Inspection by the Architect, Owner or others does not limit the Contractor's responsibilities for quality as specified herein or as required by the CSM's instructions.

B. The Contractor shall perform the quality control procedures listed below in conjunction with the requirements of this Section. The Architect will inspect the work to determine conformance to the contract documents.

1. Degree of Cleanliness:
    a. Visually inspect the degree of cleanliness of substrates to meet the requirements of this Section. The pH of the concrete substrates will be measured using pH indicating papers. pH testing is to be performed once every 100 sq. ft. of surface area to be coated.
    b. Acceptable pH values shall be between 8.0 and 11.0 as measured by a full-range (1-12) color indicating pH paper with readable color calibrations and a scale at whole numbers (minimum). Use Hydrion Insta-Chek Jumbo 0-13 or 1-12 or equal. The paper shall be touched to the surface once using moderate finger pressure. The surface shall not be wiped or moved laterally to disturb the surface during pH testing. Following the one touch, lift the paper vertically to not “wipe” the surface. Compare the color indicated with the scale provided and record the pH.
    c. Note: If the surface of the concrete is dry, it is not possible to take a pH measurement. However, pH values are still important on dry surfaces. When a dry concrete substrate is encountered for a pH test, the surface where the pH test is to be performed shall be sprayed lightly with distilled, deionized water from a commercially available spray bottle that has been properly rinsed to preclude any dissolved solids. The spray shall just wet the surface to a “shiny” appearance. Wait 60 seconds to allow chemical equilibria to be established and then test the pH of the water on the surface. Perform this test in accordance with ASTM D4262.
        1) Concrete Surface Profile
            (a) Using the replicate rubber specimens inspect the concrete surface profile in accordance with ICRI Guide No. 03732. This should be performed once for every 100 square feet of surface area to be coated.
        2) Measure and record ambient air temperature once every two hours of each shift using a thermometer and measure and record substrate temperature once every two hours using a surface thermometer.
        3) Measure and record relative humidity every two hours of each shift using a sling psychrometer in accordance with ASTM E337.

4) Inspect correct mixing of coating materials in accordance with the CSM's instructions.
5) Inspect and record that the "pot life" of coating materials used are not exceeded during installation.
6) Measure and record the thickness of the coating system using a notched gauge in accordance with ASTM D4414 for Wet Film Thickness at least once every 10 sq. ft. of coating area.
7) Perform moisture tests on concrete as follows:
   (a) Once for every 500 square feet of surface area to be coated, perform the plastic sheet test in accordance with ASTM D4263. If moisture is indicated, proceed to step 2 below.
   (b) Perform calcium chloride moisture tests in accordance with ASTM D1869 once for every 1000 square feet of surface area to be coated. The maximum limit for moisture vapor emissions rate should be 20.0 lbs. per 24 hours per 1000 sq. ft. If tests indicate rates higher than 20.0, consult with manufacturer for further evaluation.
8) Inspect to verify proper curing of the decorative epoxy flooring system as recommended by the CSM.

C. Material Sampling: Owner may at any time and any numbers of times during resinous flooring application require material samples for testing for compliance with requirements.
   1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
   2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
   3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements

END OF SECTION

SECTION 09 6813 - TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

B. Section 07 1616 - Crystalline Waterproofing: Concrete Sealent

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures. For carpeting, Owner shall also review carpet submittals.

B. Product Data: For each type of carpet material, carpet cushion, and installation accessory specified. Submit manufacturer's printed data on physical characteristics, durability, fade resistance, and fire-test-response characteristics. Submit methods of installation for each type of substrate.

C. Shop Drawings showing columns doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet. Indicate the following:
   1. Carpet type, color and dye lot.
   2. Locations where dye lot changes occur.
   3. Seam locations, types, and methods. Avoid "slivers" to the greatest extent possible; if unavoidable, "slivers" shall be located in least trafficked areas. Seams in wall openings shall be centered on the wall. If the opening has a door, seams shall be centered beneath the door in closed position.
   4. Type of subfloor.
   5. Type of installation.
   6. Pile direction.
   7. Transition details to other flooring materials.

D. Samples for verification of the following products, in manufacturer's standard sizes, showing the full range of color, texture and pattern variations expected. Prepare samples from the same material to be used for the Work. Label each sample with manufacturer's name, material type, color, pattern, and designation indicated on Drawings and carpet schedule. Submit the following:
   1. 12-inch square samples of each type of carpet material required.
   2. 12-inch samples of each type of exposed edge stripping and accessory item.

E. Schedule of carpet using same room designations indicated on Drawings.

F. Manufacturer's Installation Instructions: Indicate special procedures. Manufacturer's statement of acceptance of compatibility of concrete slab curing/sealing materials with carpet adhesive.

G. Testing Results from Indenpendent Testing Laboratory from previously manufactured carpet materials of identical type to this project illustrating compliance with specified project criteria.

H. Maintenance data for carpet to be included in the operation and maintenance manual specified in Division 1. Include the following:
   1. Methods of maintaining carpet, including manufacturer's recommended frequency for maintaining carpet.
   2. Precautions for cleaning materials and methods that could be detrimental to finishes and performance. Include cleaning and stain-removal products and procedures.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 1 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who is certified by the Floor Covering Installation Board (FCIB) or who can demonstrate compliance with FCIB certification program requirements.

B. Single-Source Responsbility: Obtain each type of carpet from one source and by a single manufacturer.

C. All carpet shall be first quality of American manufacturer and all yarn shall be BASF, ZEFTRON 2000 (R).

D. Provide flooring material to meet the following test performance criteria as tested by a recognized independent testing laboratory. Certified test reports shall be submitted by the carpet manufacturer for each test method. Requirements listed below must be met by all products being submitted for approval:
   1. Pill Test / DOC-FF-1-70 (ASTM D 2589) - Requiement: Pass
   2. Flooring Radiant Panel / ASTM E 648 - Requirements: Class I (Above 0.45 w/cm).
   3. CRI VOC Chamber Test/Indoor Air Quality test (CRI-IAQ) Green Label Plus Test.
   4. Lightfastness: Rating of not less than 5 on International Grey Scale after 40 SFU's when tested in accordance with AATCC Test Method 165.
   5. Crockfastness: Minimum stain rating on International Grey Scale of not less than 5 wet or dry when tested in accordance with AATCC Test Method 165.
   6. Atmospheric Fading: Burned Gas shall not be less than 5 on International Grey Scale after two cycles on each test as per AATCC Test Method 129 Ozone and AATCC Test Method 23.

E. Testing: Owner Provided Independent Testing Laboratory will test random samples of actual materials delivered to the site, one sample for each 10,000 sf of carpeted area illustrating compliance with specified project criteria.

1.06 DELIVERY, STORAGE AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104, Section 5: "Storage and Handling".

B. Deliver materials to Project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.

C. Store materials on-site in original undamaged packages, inside well-ventilated area protected from weather, moisture, soilage, extreme temperatures, and humidity. Lay flat, with continuous blocking off ground.

1.07 PROJECT CONDITIONS

A. Comply with CRI 104, Section 6: "Site Conditions".

B. Space Enclosure and Environmental Limitations: Do not install carpet until space is enclosed and weatherproof, wet-work in space is completed and normally dry, work above ceilings is complete and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

C. Subfloor Moisture Conditions: Moisture emission rate of not more than 3 lb/1000 sq. ft./24 hous (14.6 kg/1000 sq. m/24 hours) when tested by calcium chloride moisture test in compliance with CRI 104, 6.2.1, with subfloor temperatures not less than 55 deg F (12.7 deg C).

D. Subfloor Alkalinity Conditions: A pH range of 5 to 9 when subfloor is wetted with potable water and pHydrion paper is applied.

1.08 WARRANTY

A. The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Carpet Warranty: Submit a written warranty executed by carpet manufacturer and installer agreeing to repair or replace carpet, including all labor and material for the removal of

carpet to be replaced, slab preparation, shipping and installation of replacement material, that does not meet requirements for that fails in materials or workmanship within the specified warranty period. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

1. Warranty Period: Life of the installation.

C. Color Fastness Warranty: Submit a written warranty executed by the carpet manufacturer agreeing to repair or replace carpet, including all labor and material for the removal of carpet to be replaced, slab preparation, shipping and installation of replacement material should the yarn fail to maintain its color.
   1. Warranty Period for Lighting: Ten (10) Years
      a. Carpets shall resist change in color due to sunlight exposure to exceed the equivalent of 4.0 on the gray scale for color change as measured in accordance with AATCC Method 16E.
   2. Warranty Period for Atmospheric Conditions: Five (5) Years
      a. Capets will resist change in color due to atmostpheric contaminents (Ozone and Nitrous Oxides) as measured by AATCC 164 and AATCC 129. Tested carpet will not rate less than a 3.0 rating on the grey scale for color change.

D. Special Carpet Stain Warranty: Submit a written warranty executed by carpet manufacturer and installer agreeing to repair or replace carpet, including all labor and material for the removal of carpet to be replaced, slab preparation, shipping and installation of replacement material, and agreeing to reimburse the Owner for attempted removal of the stain should the carpet permanently stain.
   1. Warranty Period: Ten (10) Years
   2. This is not to be construed as a cleaning contract. Owner shall have attempted to remove the stain within three (3) working days after occurrence of the spill and notify carpet manufacturer immediately if the stain removal is unsuccessful.

E. Special Carpet Static Warranty: Submit a written warranty executed by carpet manufacturer and installer agreeing to repair or replace carpet, including all labor and material for the removal of carpet to be replaced, slab preparation, shipping and installation of replacement material, should carpet cause static or induce malfunction of electronic equipment when installed throughout the equipment operation area.
   1. Static is defined as the electric charge built up and later discharged from a person, cart, or other objects as a result of movement of that person or object upon the floor covering.
   2. Malfunction is defined as any failure of the electronic equipment caused by carpet induced static electricity, providee the equipment is operating within specifications in every other respect.
   3. Electronic Equipment is any computer, work processor, terminal, or other peripheral component communications processor, typesetter or broadcast equipment sold by a recognized manufacturer (or its authorized distributor, agent, or representative) and installed and serviced by qualified personnel.
   4. Warranty Period: Life of the installation

PART 2 PRODUCTS

2.01 CARPET TILE

A. Basis of Design Product (**C-1, C-2**): Subject to compliance with requirements, provide the products listed in the Drawing Finish Key. Specific carpets are identified in the drawings to establish the color, design intent, and required standard of quality. It is not the intent to preclude the use of other prior approved, acceptable manufacturers.
   1. Basis of Design: As indicated in the Finish Key
   2. Bentley: www.bentleymills.com.
   3. Interface
   4. Mannington
   5. J&J Industries
   6. Shaw Contract

7. Or Prior Approved Equal.

B. Size: As indicated in the Drawing Finish Key.

C. Applied Soil-Resistance Treatment: Manufacturer's standard material.

D. Antimicrobial Treatment: Manufacturer's standard material.

E. Performance Characteristics (C-1): As follows:
   1. Smoke Developed (Specific Optical Density): 450 or less (flaming) per NFPA 253 (NBS/AMINCO SMOKE CHAMBER)
   2. Pile Construction: Multi-Level Pattern Cut/Loop
   3. Yarn Type: Ecosolution Q100 Nylon
   4. Gauge: 1/10
   5. Stitches per Inch 9.6
   6. Finished Pile Height: 0.144 in
   7. Tufted Weight: 28 oz. / sq. yd
   8. Primary Backing: Ecoworx Tile
   9. Underlayment: None; Glue Directly to Slab
   10. Weight Density: 7,000 oz/ cu yd
   11. Pattern Repeat: None
   12. Dye Method: 100% solution-dyed; no after-manufature dye methods will be acceptable.
   13. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per AATCC 16, Option E.
   14. Elastrostatic Propensity: Less than 3.0 kV per AATCC 134.
   15. Installation: Quarter Turn

F. Performance Characteristics (C-2): As follows:
   1. Smoke Developed (Specific Optical Density): 450 or less (flaming) per NFPA 253 (NBS/AMINCO SMOKE CHAMBER)
   2. Pile Construction: Multi-Level Pattern Cut/Loop.
   3. Yarn Type: Ecosolution Q100 Nylon
   4. Gauge: 1/12
   5. Stitches per Inch 9
   6. Total Thickness: 0.294 in, 7.47 mm
   7. Finished Pile Thickness: 0.145 in, 3.68 mm
   8. Tufted Weight: 30 oz. / sq. yd.
   9. Primary Backing: Synthetic
   10. Secondary Backing: Ecoworx Tile
   11. Underlayment: None; Glue Directly to Slab
   12. Weight Density: 7,448
   13. Dye Method: 100% solution-dyed; no after-manufature dye methods will be acceptable.
   14. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per AATCC 16, Option E.
   15. Elastrostatic Propensity: Less than 3.0 kV per AATCC 134.
   16. Installation: Quarter Turn

G. Environmental Requirements: Provide carpet tile that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

2.02 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Edge Strips: Embossed aluminum, _____ color.

C. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements to installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive must be asbestos free.

D. Rubber Edge Strips: Rubber or vinyl in manufacturer's standard matching carpet, of width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting performance of carpet. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Verify that subfloors and conditions are satisfactory for carpet installation and comply with requirements specified in this Section and those of the following:
1. Carpet manufacturer.

3.02 PREPARATION

A. Comply with carpet manufacturer's installation recommendations to prepare substrates indicated to receive carpet installation.

B. Level subfloor within 1/4 inch in 10 feet noncumulative, in all directions. Sand or grind protrusions, bumps, and ridges. Patch and repair cracks and rough areas. Fill depressions.
1. Use leveling and patching compounds to fill cracks, holes, and depressions in subfloor as recommended by the following:
a. Carpet manufacturer.

C. Remove subfloor coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone.

D. Broom or vacuum clean subfloors to be covered with carpet. Following cleaning, examine subfloors for moisture, alkaline salts, carbonation, or dust.

E. Concrete-Subfloor-Preparation: Apply concrete-slab primer, according to manufacturer's directions, where recommended by the following:
1. Carpet manufacturer.

F. Coordinate on-carpet and in-carpet items including but not limited to door stops, cleanouts, floor receptacles, thresholds for proper design function and fit. Carpet flanges for floor outlets and cleanouts shall accomplish level, flush walking surface.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Comply with carpet manufacturer's recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under door in closed position. At wall openings, seams shall be centered on the wall. Do not bridge building expansion joints with continuous carpet. "Slivers" of carpet shall be avoided whereever possible, but if unavoidable shall be located in least-trafficked areas.

C. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

D. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

E. Extend carpet under all moveable furnishings, equipment or fixtures unless otherwise noted.

F. Fully adhere carpet tile to substrate.

G. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing installation.
   1. Remove visible adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
   2. Remove protruding yarns from carpet surface.
   3. Vacuum carpet using commercial machine with face-beater element.

B. Comply with CRI 104, Section 15: "Protection of Indoor Installation".

C. Provide final protection and maintenance conditions, in a manner acceptable to manufacturer and Installer, that ensure carpet is without damage or deterioration at the time of Substantial Completion.

D. Remove excess adhesive without damage, from floor, base, and wall surfaces.

E. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 7200 - WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Paper back and Vinyl Wall Coverings.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: For each type of product indicated, include data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.

C. Shop Drawings: Show location and extent of each wall-covering type. Indicate veneer matching, seams and termination points.

D. Samples for Initial Selection: For each type of wall covering indicated.

E. Samples for Verification: Full width by 36 inch long section of wall covering.
   1. Sample from same print run or dye lot to be used for the Work. Mark top and face of fabric.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall covering.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Wall Covering Materials: 25 linear feet (8 linear m) of each color and pattern of wall covering; store where directed.
   3. Package and label each roll by manufacturer, color and pattern, and destination room number.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

1.06 MOCK-UP

A. Provide panel, 5 feet (1.524 m) wide, full height, illustrating installed wall covering and joint seaming technique.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials at arrival on site, to verify acceptability.

B. Protect packaged adhesive from temperature cycling and cold temperatures.

C. Do not store roll goods on end.

1.08 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Basis of Design (WC-1): Wolf Gordon: www.wolfgordon.com
   2. DesignTex: www.designtex.com
   3. MDC Wallcoverings: www.mdcwall.com.
   4. Innovations in Wallcovering, Inc.: www.innovationsusa.com.
   5. Len-Tex Wallcoverings: lentexwallcoverings.com.
   6. DesignTex: www.designtex.com.

2.02 MATERIALS

A. Requirements for Wall Coverings:
   1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.

B. Wall Covering - Type **WC-1,** Vinyl Wall Covering:
   1. Basis of Design Product: Subject to compliance with requirements, provide the products listed in the Drawings and Finish Key. Specific wall coverings are identified in the drawings to establish color, design intent, and required standard of quality. It is not the intent to preclude the use of other prior approved, acceptable manufacturers.
      a. Basis of Design: Wolf Gordon Kabuto, Color: Abalone
      b. Or prior approved equal.
   2. Material: Mylar faced Vinyl
   3. Color: As indicated on the Drawing Finish Key
   4. Width: 52 inch roll.
   5. Pattern: Random Match, Straight Hang
   6. Backing: Non Woven.
   7. Weight: 20 oz per linear yard
   8. ASTM E84 Class A
   9. Flame Spread: 20
   10. Smoke Developed: 35
   11. Mounting: Self-Adhering

C. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and installation conditions to ensure surface conditions meet or exceed a Level 5 finish. Recommended levels of gypsum board finish, and permanent lighting should be installed and operational.

B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.

C. Verify substrate surface is clean, dry, smooth, structurally sound, and free from surface defects and imperfections that would show through the finished surface.

D. Evaluate all painted surfaces for the possiblity of pigmented bleed through.

E. Notify the Architect in writing of any conditions detrimental to the proper and timely completion of the installation.

F. Beginning of installation means acceptance of surface conditions.

3.02 PREPARATION

A. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.

B. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

3.03 INSTALLATION OF WALL COVERINGS

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply adhesive to wall surface immediately prior to application of wall covering. Let contact adhesive set tack free.

C. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface. Butt edges tightly.

D. Horizontal seams are not acceptable.

E. Do not seam within 2 inches (50 mm) of internal corners or within 6 inches (150 mm) of external corners.

F. Install wall covering before installation of bases and items attached to or spaced slightly from wall surface.

G. Cover spaces above and below windows, above doors, in pattern sequence from roll.

H. Where wall covering tucks into reveals, or metal wallboard or plaster stops, apply with contact adhesive within 6 inches (150 mm) of wall covering termination. Ensure full contact bond.

I. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

SECTION 09 9000 - PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints and other coatings.

C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished

D. Do Not Paint or Finish the Following Items:
   1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne, and lead items.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically so indicated.
   8. Ceramic and other tiles.
   9. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
   10. Glass.
   11. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Shop-primed items.

B. Section 09 9600 - High-Performance Coatings.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.

C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Provide data on all finishing products, including VOC content.

C. Samples: Submit two paper chip samples, 12 X 12 inch (400 X 400 mm) in size illustrating range of colors and textures available for each surface finishing product scheduled.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, submit each color in each sheen available.
   3. Where sheen is not specified, discuss sheen options with Grace & Hebert Architects, APAC before preparing samples, to eliminate sheens definitely not required.

D. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 12 X 12 inch (400 x 400 mm) in size.

E. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.

F. Manufacturer's Instructions: Indicate special surface preparation procedures.

G. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum seven years experience.

1.06 MOCK-UP

A. Apply mock-ups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
      b. Shower ceilings.
      c. Other items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 45 degrees F (7 degrees C) for interiors; 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.

E. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.

F. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

1.09 EXTRA MATERIALS

A. See Section 016000 - Product Requirements, for additional provisions.

B. Supply 1 gallon of each color; store where directed.

C. Label each container with color in addition to the manufacturer's label.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.

B. Provide all paint and coating products from the same manufacturer to the greatest extent possible.

C. Paints:
   1. Basis of Design (**P-1, P-2, P-3, P-4, P-5, P-6**): Sherwin Williams Company: www.sherwin-williams.com.
   2. Benjamin Moore & Co: www.benjaminmoore.com/#sle.
   3. Basis of Design (**P-7**): Scuffmaster; Master Technologies, Inc.

D. Primer Sealers: Same manufacturer as top coats.

E. Block Fillers: Same manufacturer as top coats.

F. Substitutions: Prior approved equal only.

2.02 PAINTS AND COATINGS - GENERAL

A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
   1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   4. Supply each coating material in quantity required to complete entire project's work from a single production run.
   5. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
   1. Gypsum Board: Interior Institutional Low Odor/VOC Primer Sealer.
   2. Concrete Masonry: Interior/Exterior Latex Block Filler.
   3. Galvanized Steel: Interior Water Based Galvanized Primer.

C. Volatile Organic Compound (VOC) Content:
   1. Provide coatings that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
         1) Flat Paints and Coatings: 0 g/L.
         2) Nonflat Paints and Coatings: 0 g/L.
         3) Industrial Maintenance Coatings: 250 g/L.
         4) Dry-Fog Coatings: 150 g/L.
         5) Primers, Sealers, and Undercoaters: 100 g/L.
         6) Anticorrosive and Antirust Paints Applied to Ferrous Metals: 100 g/L.
         7) Zinc-Rich Industrial Maintenance Primers: 340 g/L.
         8) Pretreatment Wash Primers: 420 g/L.
         9) Floor Coatings: 50 g/L.
         10) Shellacs Clear: 730 g/L.
         11) Shellacs, Pigmented: 550 g/L.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

D. Colors: As indicated on drawings, or as selected by Architect
   1. Allow for minimum of twelve colors for each system, unless otherwise indicated, without additional cost to Owner. Refer to Finish Key and Interior Elevations for color selections.
   2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
   3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.
   4. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.

2.03 PAINT SYSTEMS - EXTERIOR

A. All Exterior Surfaces Indicated to be Painted, Unless Otherwise Indicated: Including primed metal.
   1. Preparation as specified by manufacturer.
   2. Two top coats and one coat primer recommended by manufacturer.
   3. Primer(s): As recommended by manufacturer of top coats.

B. Ferrous Metals, Unprimed, Latex, 3 Coat:
   1. One coat of latex primer.
   2. Gloss: Two coats of latex enamel.

C. Galvanized Metals, Latex, 3 Coat:
   1. One coat galvanize primer.
   2. Gloss: Two coats of latex enamel.

2.04 PAINT SYSTEMS - INTERIOR

A. All Interior Surfaces Indicated to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete masonry, wood, uncoated steel, shop primed steel, and galvanized steel.
   1. Primer(s): As recommended by manufacturer of top coats.

B. Wood, Opaque, Latex, 3 Coat:
   1. One coat of latex primer sealer.
   2. Semi-gloss: Two coats of latex enamel.

C. Concrete/Masonry, Opaque, Latex, 3 Coat:
   1. One coat of block filler.
   2. Semi-gloss: Two coats of latex enamel.

D. Ferrous Metals, Primed, Latex, 2 Coat:
   1. Touch-up with latex primer.
   2. Semi-gloss: Two coats of latex enamel.

E. Galvanized Metals, Latex, 3 Coat:
   1. One coat galvanize primer.
   2. Semi-gloss: Two coats of latex enamel; ____.

F. Gypsum Board/Plaster, Latex, 3 Coat:
   1. One coat of latex primer sealer.
   2. Eggshell: Two coats of latex enamel; at areas specified.
   3. Flat: Two coats of latex enamel; Ceilings.

G. Gypsum Board/Plaster, Epoxy System, 3 Coat:
   1. One coat interior latex primer/sealer.
   2. Semi-gloss: Two coats of waterbased epoxy gypsum board coating; at all wet areas - restrooms, locker rooms, shower areas, etc.

H. Gypsum Board/Plaster, Metallic Coating Sysetm: system to be by Scuffmaster or prior approved equal.
   1. Prime Coat: One coat Primemaster primer/sealer acrylic.

2. Base Coats: Two coats Master-Coat.
3. Pearlescent Coat: One coat Clear Pearl Coat.
4. Clear Coat: One coat Ultra-clear (satin).

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Gypsum Wallboard: 12 percent.
2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to coating application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.

H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

I. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

J. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

K. Interior Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

3.03 APPLICATION

A. Apply paints according to manufacturer's written instructions:
   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
   1. Refer to Divisions 21, 22, 23, 26, 27 and 28 for painting requirements where indicated.

3.04 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION

SECTION 09 9600 - HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High performance coatings.

B. Surface preparation.

1.02 RELATED REQUIREMENTS

A. Section 09 9000 - Painting and Coating: Requirements for mechanical and electrical equipment surfaces.

1.03 SUBMITTALS

A. See Section 01 3000 - Submittal Requirements.

B. Product Data: Provide data indicating coating materials .

C. Samples: Submit two samples 8 by 8 inch (203 by 203 mm) in size illustrating colors available for selection.

D. Samples for Verification Purposes: Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.
   1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
   2. Provide a list of material and application for each coat of each sample. Label each sample as to location and application.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Maintenance Data: Include cleaning procedures and repair and patching techniques.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Coating Materials: 1 gallon (4 liters) of each type and color.
   2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.04 QUALITY ASSURANCE

A. Maintain one copy of each referenced document that applies to application on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

C. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

D. Field Samples: On wall surfaces and other exterior and interior components, duplicate finishes of prepared samples. Provide full-coat finish samples on at least 100 sq. ft. of surface until required sheen, color, and texture are obtained; simulate finished lighting conditions for reivew of in-place work.
   1. Final acceptance of colors will be from job-applied samples.
   2. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted. Apply coatings in this room or surface according to the schedule or as specified.
      a. After finishes are accepted, this room or surface will be used to evaluate coating systems of a similar nature.

1.05 FIELD CONDITIONS

A. Do not install materials when temperature is below 55 degrees F (13 degrees C) or above 90 degrees F (32 degrees C).

B. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

C. Restrict traffic from area where coating is being applied or is curing.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for bond to substrate.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. High-Performance Coatings:
   1. Sherwin-Williams Company; _____: www.protective.sherwin-williams.com/industries
      a. Polyamide Epoxy: B58W00610 Macropoxy 646 Fast Cure Epoxy Part A Mill White
      b. Fluoropolymer: B65W00580 Fluorokem Hi-Solids Fluoropolymer Urethane Part A Extra White
      c. Acrylic Primer: B66W00310 ProIndustrial Pro-Cryl Universal Acrylic Primer
      d. Self-Crosslinking Acrylic: B66W01551 ProIndustrial Multi-Surface Self-Crosslinking Acrylic
   2. Basis of Design: Tnemec Company, Inc: www.tnemec.com.
   3. Or approved equal..

2.02 HIGH-PERFORMANCE COATINGS

A. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:

2.03 TOP COAT MATERIALS

A. Material Compatibility: Provide primers, intermediate coats and finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.

B. Materials shall meet the requirements outlined below. No materials will be considered that differ generically from the specified system.

C. Very high performance coating materials are compatible with intumescent fireproofing.

D. Material Requirements:
   1. Polyamide Epoxy
      a. ASTM D 4541 Adhesion (Type V)
         1) No less than 1900 psi
      b. Exterior Exposure
         1) No blistering, cracking, or delamination of film and no creepage at scribe after 72 months.
      c. ASTM D 4585 Humidty
         1) No blistering, cracking, rusting, or delamination after 4500 hours.
   2. Aliphatic Acrylic Polyurethane
      a. ASTM D 4541 Adhesion (Type V)
         1) No less than 1750 psi
      b. ASTM D 4141 Method C (EMMAQUA)
         1) No blistering, cracking or chalking. No less than 70% glass retention after 500 MJ exposure.
      c. ASTM D 4587 QUV (UVA - 340 bulbs, Cycle 4; 8 hours UV; 4 hours condensation)
         1) No blistering, cracking, or chalking. No less than 96% gloss retention after 2000 hours exposure.
      d. Minimum 60% volume solids.
   3. Fluoropolymer
      a. ASTM D 4541 Adhesion (Type V)
         1) No less than 1750 psi.
      b. ASTM D 4141 Method C (EMMAQUA)

1) No blistering, cracking or chalking. No less than 96% gloss retention after 1250 MJ/m2 EMMAQUA exposure.

c. ASTM D 4587 QUV (UVA - 340 bulbs, Cyle 4: 8 hours UV, 4 hours condensation)
1) No blistering, cracking or chalking. No less than 93% gloss retention after 10,000 hours exposure.

d. Minimum 60% volume solids.

4. Self Crosslinking Acrylic
a. Test Method: ASTM D 4541 Adhesion, (Type V Tester)
1) Requirement: No less than 1400 psi.

b. Test Method: ASTM D 4585 Humidty
1) Requirement: No blistering, cracking, rusting or delamination of film after 2,000 hours exposure.

c. Test Method; ASTM D 5894 Corrosion Resistance
1) Requirement: No blistering, cracking or delamination adn no more than 8 rusting of film after 2,500 hours.

d. Test Method: ASTM D 522 Flexibility (Method A Conical Mandrel Bend)
1) Requirement: No less than 3% elongation, average of three tests.

E. Primers: As recommended by coating manufacturer for specific substrate, unless otherwise specified.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
1. Do not begin to apply paint until unsatisfactory conditions have been corrected.
2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
1. Notify the Architect about anticpated problems using the materials specified over substrates primed by others.

C. Do not begin application of coatings until substrates have been properly prepared.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

3.02 PREPARATION

A. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease prior to cleaning. Schedule cleaning and painting so dust and other contaimants from the cleaning process will not fall on wet, newly painted surfaces.

B. Surface Preparation: Clean and prepare surfaces to be painted according to the manufacturer's instructions for each particular substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect in writing about anticipated problems using the specified finish-coat material with substrates primed by others.
2. Ferrous Metals (Shop Primed):
a. Touch-up for Exterior Surfaces: All failed areas shall be power tool cleaned to bare metal in accordance with SSPC-SP11. All edges shall be feathered to create a smooth transition. Touch up bare areas and touch up with the same primer as the shop coat.

b. Touch-up for Interior Surfaces: All failed areas shall be power tool cleaned to bare metal in accordance with SSPC-SP3. All edges shall be feathered to create a smooth transition. Touch up bare areas and touch up with the same primer as the shop coat.

3. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so that the surface is free of oil and surface contaimanants. Treat all surfaces to be coated using either method #1 or method #2.
   a. Method #1: Abrasive blast all surfaces to be coated to remove all insoluble surface contaminants and to achieve a uniformly profiled surface.
   b. Method #2: Power tool clean all surfaces to remove all insoluble surface contaminants. Treat all surfaces to be coated with GalvaPrep 5 or equal in accordance with manufacturer's instructions.

C. Materials Preparation: Carefully mix and prepare paint materials according to manufacturer's directions.
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
   2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
   3. Use only thinners approved by the paint manufacturer and only within recommended limits.

3.03 PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.04 APPLICATION

A. General: Apply paint according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
   1. Paint colors, surface treatments, and finishes are indicated in the schedules.
   2. Provide finish coats that are compatible with primers used.
   3. The number of coats and the film thickness required are the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce a smooth even surface according to the manufacturer's directions.
   4. Apply additional coats if undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
   5. The term exposed surfaces includes areas visible when permanent or built in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.

C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
   1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

D. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to the manufacturer's directions.

E. Minimum Coating Thickness: Apply materials no thinner than the manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

F. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

G. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.

H. Pigmented (Opaque) Finishes: Completely cover to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

3.05 CLEANING

A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
   1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

B. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

C. Clean surfaces immediately of overspray, splatter, and excess material.

D. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
   1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.07 SCHEDULE

A. Exterior Applications - General: Provide the following paint system for the various substrates, as indicated:
   1. Structural Steel
      a. Shop & Touch-up Primer: As specified in Section 05 1200
      b. 1st Coat: Polyamide Epoxy 2.0-3.0 dry mils
      c. 2nd Coat*: Fluoropolymer 2.5-3.0 dry mils
         * Two coats required if applied by roller.

      For each system, there should be a noticeable contrast in color between the first and second coat.

B. Interior Applications - General: Provide the following paint system for the various substrates, as indicated:
   1. Overhead Exposed Steel
      a. Shop & Touch-up Primer: As specified in Section 05 1200
      b. 1st Coat: Self Crosslinking Acylic 3.0-4.0 dry mils

      Note: A test patch is required to verify adhesion of the field applied coating with the shop applied coating.

END OF SECTION

SECTION 10 1400 - SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Handicapped Bathroom Signage

B. Emergency Exit Signage

C. Room and door signs.

D. Dimensional letters of cast metal composition

E. Dimensional Acrylic Letters

F. Interior dimensional letters of pressure sensitive, adhesive applied, digitally cut, vinyl composition.

G. Emergency evacuation maps.

1.02 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

D. ATBCB ADAAG - Americans with Disabilities Act Accessibility Guidelines; 2002.

1.03 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures, for submittal process.

B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
   1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
   2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
   3. Submit for approval by Owner through Architect prior to fabrication.

D. Shop Drawings:
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
   3. Show message list, typestyles, graphic elements, and layout for plaque at least half size.
   4. Show locations of electrical service connections.
   5. Include diagrams for power, signal, and control wiring.

E. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.

F. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.

G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

H. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

1.05 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flat Signs:
   1. **Basis of Design Manufacturer**: ASI Signage Innovations, 1101 24th Street Kenner, LA 70062-5266. Ph. (504) 704-1000, or prior approved equal.
   2. Contact: Kevin Leaumont, Ph. (504) 704-1000x113.
      a. Sign Type Drawings:(Re: Drawing) — Location:
         1) Sign Type I - 8" x 6" — ADA Compliant Toilet Room
         2) Sign Type II - 8" x 6" — ADA Compliant Toilet Room
         3) Sign Type III - 4" x 8" — Low Level Exits as required by code

B. Dimensional Acrylic Letters, Pin Mounted.
   1. ASI Signage Innovations - Product ASI LPP Series Acrylic Dimensional Letters.

C. Dimensional Letter Signs:
   1. ASI Sign Systems, Inc. - Product: Series LC Cast Metal Dimensional Letters.
   2. Or approved equal.

2.02 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
   1. Sign Type: Flat signs with injection molded panel media as specified.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
   3. Character Height: As indicated in drawings.
   4. Sign Height: As indicated in drawings by signage type designation.
   5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
   6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
   7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
   8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

C. Dimensional letters of cast metal composition.
   1. Approved Manufacturer: ASI Signage Innovations, 1101 24th Street Kenner, LA 70062-5266. Ph. (504) 704-1000.
      a. Contact: Kevin Leaumont, Ph. (504) 704-1000x113.
   2. Basis of Design Product: ASI LC Series, Cast Metal Dimensional Letters.
   3. Material: Cast Bronze
   4. Finish: Metal finish to be selected by Architect from manufacturer's full range.
   5. Fabricated Letters:
      a. Letter Style: As indicated in Drawings

b. Letter Height: As indicated in Drawings
c. Letter Depth: As indicated in Drawings.

6. Letters: 1 layer of acrylic 1/2 inch thick. Returns and backs of letters painted MX-15 Satin Aluminum metallic.
7. Mounting Method: Flush stud mount, unless indicated otherwise.

D. Interior digitally cut, vinyl composition dimensional letters.
1. Approved Manufacturer: ASI Signage Innovations, 1101 24th Street Kenner, LA 70062-5266. Ph. (504) 704-1000.
a. Contact: Kevin Leaumont, Ph. (504) 704-1000x113.
2. Basis of Design Product: ASI LTV Series, Digitally Cut Vinyl Letters.
3. Material: 2 mil cast vinyl film, of integral color as selected by Architect from manufacturer's full range.
4. Fabricated Letter:
a. Letterstyle: San Serif
b. Height: As indicated in drawings.
c. Color(s): As selected by Architect from manufacturer's full range.
d. Mounting Method: Pressure sensitive adhesive.

E. Emergency Evacuation Maps:
1. Allow for ten evacuation maps.
2. Map content to be provided by Owner.
3. Size: 8" x 10"

2.03 SIGN TYPES

A. General: **FINAL DESIGN OF SIGNS TO BE COORDINATED WITH FRANKLIN FOUNDATION HOSPITAL STANDARDS.**

B. Flat Signs: Signage media without frame but with aluminum edge banding at top, bottom and center as indicated in Drawings..
1. Edges: Square.
2. Corners: Square.
3. Wall Mounting of One-Sided Signs: Tape adhesive.

C. Color and Font Flat Signs: **FINAL DESIGN OF SIGNS TO BE COORDINATED WITH OWNER'S BRANDING STANDARDS**:
1. Character Font: Helvetica Regular.
2. Character Case: Upper case only.
3. Insert Color: To be coordinated with Owner's branding standards.
4. Vinyl Color: To be coordinated with Owner's branding standards.
5. Edge Style: Slimline
6. End Cap Color: To be coordinated with Owner's branding standards.
7. Character Color: To be coordinated with Owner's branding standards.
8. Background Color: To be coordinated with Owner's branding standards.

2.04 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
1. Total Thickness: 1/8 inch (3 mm).

B. Injection Molded Panels: One-piece acrylic plastic, with raised letters and braille.
1. Total Thickness: 1/8 inch (3 mm).

C. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.
1. Total Thickness: 1/8 inch (3 mm).
2. Letter Thickness: 1/8 inch (3 mm).
3. Letter Edges: Square.

2.05 DIMENSIONAL LETTERS

A. Fabricated Characters: Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability and for securing fasteners; and as follows:
   1. Manufacturers: As indicated above.
   2. Typeface: As indicated.

B. Metal Letters:
   1. Metal: Aluminum casting.
   2. Finish: As selected by Architect from manufacturer's full range..
   3. Product: As indicated above in Paragraph 2.01.C..
   4. Character Height: As indicated in drawings.
   5. Mounting: Concealed screws.

C. Plastic / Acrylic Letters:
   1. Material: Acrylic plastic sheet, flat.
   2. Color: As selected from Manufacturer's full range.
   3. Face Finish: TBD
   4. Edge Finish: All exposed Edges to be painted to Match Adjacent Finish.
   5. Thickness: 1/2"
   6. Height: As Indicated in Drawings
   7. Font: As Indicated in Drawings
   8. Product: As indicated above in Paragraph 2.01.B..
   9. Mounting: Pin Mounted.
   10. Verbiage: As provided by Onwer.

2.06 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.07 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signag, noncorrosive and compatible with each material joined, and complying with the following:
   1. Use concealed fasteners and anchors unless indicated to be exposed.
   2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
   3. Exposed Metal-Fastener Components, Genera:
      a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
      b. Fastener Heads: For nonstructural connections, use flathead or countersunk screws and bolts with tamper-resistant Allen-head, spanner-head, or one-way-head slots unless otherwise indicated.
   4. Sign Mounting Fasteners:
      a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
      b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

B. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

C. Tape Adhesive: Double sided tape, permanent adhesive, for flat signs

2.08 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
   1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
   2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
   3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
   4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
   5. Internally brace signs for stability and for securing fasteners.
   6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
   7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
   1. Aluminum Brackets: Factory finish brackets to match sign background finish unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of plaque work.

B. Verify that sign-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.

C. Verify that electrical service is correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
   1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
   2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
   3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Install in accordance with manufacturer's instructions.

C. Install neatly, with horizontal edges level.

D. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

E. Mounting Methods:
   1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
      a. Masonry and Concrete Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
   2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
   3. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
   4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
   5. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of plaque and of suitable quantity to support weight of plaque without slippage. Keep strips away from edges to prevent visibility at plaque edges. Place plaque in position, and push to engage tape adhesive.

3.03 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

D. Protect from damage until Substantial Completion; repair or replace damaged items.

3.04 SCHEDULE OF SIGNAGE

A. Interior Room Signage:
   1. Provide one handicapped toilet accessable sign for each restroom.
   2. Provide one room sign per Mechanical, Electrical, Janitor, IT, and similar service room entry door.
   3. Provide exit sign for each exterior door.
   4. Provide one sign per interior door, office, patient room, etc.

B. Provide Lobby Signage:
   1. Dr. Names as indicated in Interior Elevations
   2.

C. Exterior Signage:
   1. Provide weather rated exterior sign at doors to service rooms on the exterior of the building.

D. Job Sign:
   1. Provide 3 - 4' x 8' sheet of plywood or masonite with Owner directed signage to be included for project job sign. Mount on 4 x 4 posts or as needed to stand for duration of project.

E. Exterior Address Signs:

1. Provide a vinyl number sign above the front entry doors to the building on glass. 8" minimum high.
2. Provide aluminum cast numbers large enough, 8" minimum, to meet local FD requirements in location to be determined by AHJ.

END OF SECTION

SECTION 10 2123 - CURTAIN TRACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface mounted overhead curtain track and guides.

B. Cubicle curtains.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Track supports above ceiling.

B. Section 06 1000 - Rough Carpentry: Blocking and supports for track.

C. Section 09 5100 - Acoustical Ceilings: Suspended ceiling system to support track.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.

1.04 PERFORMANCE REQUIREMENTS

A. Curtians: Provide curtain fabrics with the following characteristics.
   1. Fabrics are landerable to a temperature of not less than 160 deg F (71 deg C).
   2. Fabrics are flame resistant and are identical to those that have passed NFPA 701 when tested by a testing and inspecting agency acceptable to authorities having jurisdiction (AHI)

1.05 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Provide data for track material and characteristics.

C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details. Show layout and types of cubicle curtains, sizes of curtains, and number of carriers.

D. Samples:
   1. Submit 4 inch (102 mm) sample length of curtain track including typical splice, wall and ceiling hanger, and escutcheon.
   2. Curtain Fabric: 12 inch square swatch or larger sample as required to show complete pattern repeat, from dye lot used for the work, with specified treatments applied.
   3. Mesh Top: Not less than 4 inches square, demonstrating manufacturer's standard hemming around mesh perimeter with matching fabric.

E. Cubicle Schedule: Use same room designations as indicated on drawings.

F. Maintenance Data: Include recommended cleaning methods and materials and stain removal methods.

1.06 MOCK-UP

A. Locate where directed.

B. Mock-up may remain as part of the Work if approved by the Architect..

1.07 PROJECT CONDITIONS

A. Environmental Conditions: Do not install cubicles until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements; Where cubicles are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Accept curtain materials on site and inspect for damage.

B. Store curtain materials on site and deliver to Owner for installation when requested.

C. Deliver materials in unopened factory packaging.

1.09 WARRANY

A. Manufacturer's standard one year warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cubicle Track and Curtains:
   1. Construction Specialties, Inc; ____: www.c-sgroup.com/#sle.
   2. Or prior approved equal.

2.02 TRACKS AND TRACK COMPONENTS

A. Curtain Tracks: Surface-mounted tracks of heavy extruded aluminum alloy 6063-T5, 29/32" x 11/16", slotted to receive roller carriers, complete with accessories and components required for complete and secure installations including splices, end caps and corner bends.
   1. Basis of Design: CS Cubicle Curtains #NL6062 Narrowline Surface Mounted Track System

B. Corner Bends: Corner bends up to 36” radius are to be fabricated in one continuous “L” shape. Radiuses above 36” to be continuous or spliced based on room condition.
   1. Finish: Aluminum with White Powder Coat

C. Carriers:
   1. CS Cubicle Curtains NL1062, virgin nylon axle with nylon wheels complete with nickel-plated brass dual hook assembly.
      a. Provide one carrier for each 6" of cubicle curtain width.

D. Installation Accessories: Types required for specified mounting method and substrate conditions.

2.03 CURTAINS

A. Cubicle Curtains:
   1. Basis of Design: Construction Specialties Snap Lock Cubicle Curtain with Continuous Nylon Mesh Header and Curtain Tie-backs; Bark-Rain Cloud
   2. Materials:
      a. Cubicle Curtain Fabric: Provide 100% Polyester curtains. Fabric is to be opaque, washable, flame retardant and closely woven.
      b. Pattern and Color: As Indicated on Finish Key.
   3. Antimicrobial Treatment:
      a. Nanotex + BioAM spill & stain resistant treatment combined with and antimicrobial agent for protection of fabrics within healthcare settings.
   4. Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   5. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test.
   6. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, manufacturer's standard color.

B. Curtain Fabrication:
   1. Curtain Top: CS Snap Lock mesh header, not less than 20" (510mm) wide nylon mesh with 1/2" (13mm) holes. Mesh to have a perimeter framing fabicated from the same fabric as the body of the curtain. Overlap seams and double-lock stitch to body of curtain.
      a. Body of curtain to be removable from mesh header.
      b. Snap system to be sewn to body and mesh of curtain using a double needle interlocked stitch.

c. Top hem is to be double folded to conceal the snap system and provide a finished appearane front and back.

2. Width: Curtain width to be fabricated as follows:
   a. In full size units equal to track length from which curtain is hung plus 10 percent, but not less than 12" (300mm).
3. Length: Equal to floor-to ceiling height minus 2" from finished ceiling at top and 12" above finished floor.
4. Top Hem: not less than 1" (26mm) and not more than 1 1/2" (40mm) wide, triple thickness, reinforced with integral web and double stitched.
   a. Grommets: 2 piece, rolled edge, rustproof, nickel plated brass and spaced not more than 6" (150mm) o.c.
5. Bottom and Side Hems: Not less than 1" (25mm) wide, reinforced, triple thickness and single stitched.
6. Seams: Not less than 1/2" (13mm) wide, double turned and double stitched.
7. Snap Options:
   a. Snap Curtain (has its own mesh header) panel width is 69", length varies based on requirement.
   b. SnapLock system (has 1 mesh header and multiply panels depending on track length) panels are 69 69 mesh varies to alter overall height.
   c. Custom Snap Curtain(has 1 mesh header and 1 panel with snaps that detaches from the mesh up to 220" wide)
8. Curtain Tie-back: At each termination.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.

B. Verify that field measurements are as indicated.

3.02 INSTALLATION

A. Install curtain track to be secure, rigid, and true to ceiling line.

B. Mount tracks securely to blocking above ceiling. Space fasteners maximum 12" on center.

C. Install track carriers, and other fittings in accordance with manufacturers' written instructions.

D. Install end cap or stop device.

E. Secure or suspend track to ceiling system. Install with mechanical fasteners or T-Grid clips.

F. Install curtains on carriers ensuring smooth operation.

G. Demonstrate that all track assemblies and moving parts function properly.

3.03 CLEANING

A. At completion of installation, remove any debris and clean surfaces in accordance with the manufacturer's cleaning and maintenance instructions.

END OF SECTION

SECTION 10 2600 - RIGID SHEET WALL PROTECTION

PART 1 – GENERAL

1.01 SUMMARY

A. Non PVC sheet for wall protection and decoration

1.02 SECTION INCLUDES

A. Rigid Sheet Wall Protection

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

B. National Fire Protection Association (NFPA)

C. Society of Automotive Engineers (SAE)

1.04 SYSTEM DESCRIPTION

A. Performance Requirements: Provide Rigid Wall Protection Sheet that conforms to the following requirements of regulatory agencies and the manufacturer's quality control.

1. Fire Performance Characteristics: Provide Rigid Wall Protection Sheet material conforming with the NFPA Class A fire rating. Surface burning characteristics, as determined by ASTM E-84, shall be flame spread of 25 or less and smoke development of 450 or less.
2. Impact Strength: Provide materials that have been tested in accordance with the applicable provisions of ASTM D-256, Impact Resistance of Plastics.
3. Chemical and Stain Resistance: Provide material that shows resistance to stain when tested in accordance with applicable provisions of ASTM D-543.
4. Fungal and Bacterial Resistance: Provide material that does not support fungal or bacterial growth as tested in accordance with ASTM G-21 and ASTM G-22.
5. GREENGUARD Certified: Provide GREENGUARD Certified sheet. Sheet shall meet the requirements of GREENGUARD Certification Standards for Low-Emitting Products and GREENGUARD Product Emission Standard for Children & Schools.
6. Color Consistency: Provide components matched in accordance with SAE J-1545 - (Delta E) with a color difference no greater than 1.5 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems.

1.05 SUBMITTALS

A. Product Data: Manufacturer's printed product data for each type of Rigid Wall Protection Sheet specified.

B. Detail Drawings: Mounting details with the appropriate adhesives for specific project substrates.

C. Samples: Verification samples of Rigid Wall Protection Sheet, 8" (203mm) square, of each type and color indicated.

D. Manufacturer's Installation Instruction: Printed installation instructions for Rigid Wall Protection Sheet.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in unopened factory packaging to the jobsite

B. Inspect materials at delivery to assure that specified products have been received.

C. Store in original packaging in a climate controlled location away from direct sunlight.

1.07 PROJECT CONDITIONS

A. Environmental Requirements: Products must be installed in an interior climate controlled environment.

1.08 WARRANTY

A. Standard Manufacturer's Limited Lifetime Warranty against material and manufacturing defects.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturer: IPC Door and Wall Protection Systems™, InPro Corporation, PO Box 406, Muskego, WI 53150, USA Telephone: 800.222.5556, Fax: 888.715.8407, www.inprocorp.com

B. Or prior approved equal.

C. Provide all Rigid Wall Protection Sheet and wall protection from a single source.

2.02 MANUFACTURED UNITS

A. Basis of Design **(WP-1, WP-2, WP-3, WP-4, WP-5, WP-6)**: Palladium® G2 Sheet
   1. Palladium® G2 Sheet Item # G2-405
      a. Thickness: .040" (1mm)
      b. Dimensions: 4' x 10' (1.22m x 3.04m)
   2. Accessories:
      a. Non PVC
      b. G2-408 Vertical Divider Bar; Length: 8' (2.44m) standard, 10' (3.04m) available
         1) Provide Length as Necessary to avoid seams
      c. G2-409 Inside Corner; Length: 8' (2.44m) standard, 10' (3.04m) available
         1) Provide Length as Necessary to avoid seams
      d. Color Matched Caulk

2.03 MATERIALS

A. Rigid Wall Protection sheet material shall be extruded from chemical and stain-resistant reformulated PETG.

2.04 ACCESSORIES

A. Top caps, vertical divider bars and inside corners:

B. Accessory trim pieces shall be extruded from chemical and stain resistant non-PVC thermoplastic.

C. Color Matched Caulk

D. Freeze-thaw stable, nonflammable, high strength, water based adhesive
   1. Basis of Design: InPro Bond

E. Nonflammable, high strength, water dispersed contact adhesive
   1. Basis of Design: Fastbond 30

2.05 FINISHES

A. Color of Rigid Wall Protection Sheet as Indicated in Finish Key or to be selected by the architect from the manufacturer's full range. Surface shall have a velvet texture.
   1. Provide Custom Colors where Indicated in the Finish Key.

B. Accessories: Color matched caulk shall be of a color matching the Rigid Wall Protection sheet material.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions in which the sheet will be installed.
   1. Complete all finishing operations, including painting, before beginning installation of Non PVC sheet materials.
      a. Wall surface shall be dry and free from dirt, grease and loose paint.

3.02 PREPARATION

A. General: Prior to installation, clean substrate to remove dust, debris and loose particles.

3.03 INSTALLATION

A. General: Locate the Rigid Wall Protection Sheet as indicated on the approved detail drawing for the appropriate substrate and in compliance with the manufacturer's installation instructions. Install level and plumb at the height indicated on the drawings.

B. Installation of Rigid Wall Protection Sheet
   1. Adhere to substrate with manufacturer's freeze-thaw stable, nonflammable, high strength, water based adhesive that trowels on and allows approximately 20 minutes working time before firming.
   2. Adhere to substrate with manufacturer's nonflammable, high strength, water dispersed contact adhesive, with very little odor. Smooth roll surface.

3.04 CLEANING

A. At completion of the installation, clean surfaces in accordance the manufacturer's cleanup and maintenance instructions.

END OF SECTION

SECTION 10 2601 - WALL AND CORNER GUARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall Guards/Crash rails.

B. Corner guards.

C. Corridor handrails.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Wall construction.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.

C. Detail Drawings: Mounting details with the appropriate fasteners for specific project substrates

D. Samples: Submit two sections each of chair rail, handrail, and corner guard, 8 inch (____ mm) long, illustrating component design, configuration, color and finish.

E. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in unopened factory packaging to the jobsite

B. Inspect materials at delivery to assure that specified products have been received.

C. Store in original packaging in a climate controlled location away from direct sunlight

1.06 PROJECT CONDITIONS

A. Environmental Requirements: Products must be installed in an interior climate controlled environment.

1.07 WARRANTY

A. Manufacturer's limited lifetime warranty for wall guards / crash rails, corridor handrails, and corner guards.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wall and Corner Guards:
   1. Surface Mounted Corner Guard **(CG-1, CG-2, CG-3, CG-4, CG-5, CG-6)**: 1 1/2" wings, direct glued.
      a. Manufacturers:
         1) Inpro Corporation: Tape On Corner Guard
         2) Or Prior Approved Equal
   2. High Impact Surface Mounted Corner Guard w/ Aluminum Retainer (**CG-7, CG-11, CG-12, CG-13, CG-14, CG-15, CG-16**): 3" wing, direct screw, vinyl cover.
      a. Manufacturers:

1) Inpro Corporation: 150 Series Hi-Impact Corner Guard
2) Or Prior Approved Equal.

3. Wall Guard / Crash Rail **(CR-1, CR-2, CR-3, CR-4, CR-5, CR-6)**: 5 1/2" high wall guard
   a. Manufacturer:
      1) Inpro Corporation: 1400 Series Wall Guard - 5 1/2 high by 1" deep, inner impact bumper.
      2) Or Prior Approved Equal
4. Handrails **(HR-1, HR-2, HR-3, HR-4, HR-5, HR-6)**: Vinyl Cover Handrail with Aluminum Retainer
   a. Manufacturer:
      1) Inpro Corportation: 800 Handrail.
      2) Or Prior Approved Equal.

2.02 COMPONENTS

A. Corridor Handrails: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
   1. Performance Requirements:
      a. Fire Performance Characteristics: Provide UL Classified handrails conforming with NFPA Class A fire rating. Surface burning characteristics, as determined by UL-723 (ASTM E-84), shall be flame spread of 10 and smoke development of 350 - 450. Provide ULC (Canada) listed handrails conforming to the requirements of the National Building Code of Canada 2010, Subsection 3.1.13. Surface burning characteristics, as determined by CAN/ULCS102.2, shall be flame spread of 15 and smoke developed of 35.
      b. Self-Extinguishing: Provide handrails with a CC1 classification, as tested in accordance with the procedures specified in ASTM D-635-74, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position, as referenced in UBC 52-4-1988.
      c. Impact Strength: Provide rigid vinyl profile materials that have an Impact Strength of 30.2 ft-lbs/inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics.
      d. System Impact Resistance: Provide a handrail system that resists an impact of 45.5 ft-lbs while producing no visual blemishes upon the vinyl cover surface and no deformations in the aluminum retainers, as tested in accordance with applicable provisions of ASTM F 476-84, paragraph 18, Impact Test.
      e. Chemical and Stain Resistance: Provide handrails that show resistance to stain when tested in accordance with applicable provisions of ASTM D-543.
      f. Fungal and Bacterial Resistance: Provide rigid vinyl that does not support fungal or bacterial growth as tested in accordance with ASTM G-21 and ASTM G-22.
      g. 7. Color Consistency: Provide components matched in accordance with SAE J-1545 - (Delta E) with a color difference no greater than 1.0 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems.
      h. 8. Code Compliance: Provide handrails that comply with all current ANSI and ADA requirements. In California, IPC Handrails are approved by OSHPD for use in Hospitals. OSHPD approval #R-0232
   2. Comply with accessibility requirements of ICC A117.1 and ADA Standards.
   3. Performance of Installed Assembly:
      a. Support vertical live load of 100 lb/lineal ft (1,400 N/m) with deflection not to exceed 1/50 of span between supports.
      b. Resist lateral force of 250 lbs (1112 N) at any point without damage or permanent set.
   4. Handrail Profile: 5-1/2" (140mm) height x 1-1/2" (38mm) gripping diameter, extends 3" (76mm) from wall.
   5. Materials:
      a. Vinyl: Snap-on covers of .080" (2mm) thickness shall be extruded from chemical and stain resistant unplasticized polyvinyl chloride (uPVC) with the addition of impact

modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth). Accent strips when used shall be of polyvinyl chloride (PVC).

b. Aluminum: Continuous aluminum retainer of .080" (2mm) thickness shall be fabricated from 6063-T5 aluminum with a mill finish

6. Components:
   a. Returns, inside corners, outside corners and brackets shall be made of injection molded thermoplastics.
   b. Molded reveals shall have a smooth finish and shall be black.
   c. Fasteners: All mounting system accessories appropriate for substrates indicated on the drawing shall be provided
7. Finishes:
   a. Vinyl Covers: Handrail colors to be selected by the architect from the IPC finish selection.
   b. Molded components: Returns, inside corners and outside corners shall be of a color matching the handrails. Surface shall have a pebblette texture.
   c. Molded Bracket: Shall be a solid color to match or compliment the handrails. Surface shall have a peblette texture

B. Corner Guards - Surface Mounted - Tape On Corner Guards:
1. Performance Requirements:
   a. Fire Performance Characteristics: Provide UL Classified corner guards conforming with NFPA Class A fire rating. Surface burning characteristics, as determined by UL-723 (ASTM E-84), shall be flame spread of 10 and smoke development of 350 - 450. Provide ULC (Canada) listed corner guards conforming to the requirements of the National Building Code of Canada 2010, Subsection 3.1.13. Surface burning characteristics, as determined by CAN/ULC-S102.2, shall be flame spread of 15 and smoke developed of 35.
   b. Self Extinguishing: Provide corner guards with a CC1 classification, as tested in accordance with the procedures specified in ASTM D-635-74, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position, as referenced in UBC 52-4-1988.
   c. Impact Strength: Provide rigid vinyl profile materials that have an Impact Strength of 30.2 ft-lbs/inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics.
   d. Chemical and Stain Resistance: Provide corner guards that show resistance to stain when tested in accordance with applicable provisions of ASTM D-543
   e. Fungal and Bacterial Resistance: Provide rigid vinyl that does not support fungal or bacterial growth as tested in accordance with ASTM G-21 and ASTM G-22.
   f. Color Consistency: Provide components matched in accordance with SAE J-1545 - (Delta E) with a color difference no greater than 1.0 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems
2. Corner Guard Profile:
   a. 1-1/2" (38mm) x 1-1/2" (38mm) 90 degree
   b. 1-1/2" (38mm) x 1-1/2" (38mm) 135 degree
3. Material:
   a. Vinyl: Corner guard of .080" (2mm) thickness shall be made from chemical and stain-resistant unplasticized polyvinyl chloride (uPVC) with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth).
4. Components:
   a. Attachments
      1) Tape: Factory applied double faced foam tape.
      2) Adhesive: Field applied heavy duty adhesive
5. Finishes:
   a. Vinyl: Colors of the corner guard to be selected by the architect from the IPC finish selection. Surface shall have a pebblette texture
6. Length: One piece.

C. Corner Guards - Surface Mounted - Hi Impact Corner Guard with Aluminum Retainer:
   1. Performance Requirements:
      a. Fire Performance Characteristics: Provide UL Classified corner guards conforming with NFPA Class A fire rating. Surface burning characteristics, as determined by UL-723 (ASTM E-84), shall be flame spread of 10 and smoke development of 350 - 450. Provide ULC (Canada) listed corner guards conforming to the requirements of the National Building Code of Canada 2010, Subsection 3.1.13. Surface burning characteristics, as determined by CAN/ULC-S102.2, shall be flame spread of 15 and smoke developed of 35.
      b. Self Extinguishing: Provide corner guards with a CC1 classification, as tested in accordance with the procedures specified in ASTM D-635-74, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position, as referenced in UBC 52-4-1988.
      c. Impact Strength: Provide rigid vinyl profile materials that have an Impact Strength of 30.2 ft-lbs/inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics.
      d. Chemical and Stain Resistance: Provide corner guards that show resistance to stain when tested in accordance with applicable provisions of ASTM D-543.
      e. Fungal and Bacterial Resistance: Provide rigid vinyl that does not support fungal or bacterial growth as tested in accordance with ASTM G-21 and ASTM G-22.
      f. Color Consistency: Provide components matched in accordance with SAE J-1545 - (Delta E) with a color difference no greater than 1.0 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems
   2. Corner Guard Profile:
      a. 3" (76mm) x 3" (76mm), 90 degree
   3. Material:
      a. Vinyl: Snap on cover of .080" (2mm) thickness shall be made from chemical and stain-resistant unplasticized polyvinyl chloride (uPVC) with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth).
      b. Aluminum: Continuous aluminum retainer of .070" (1.8mm) thickness shall be fabricated from 6063-T5 aluminum, with a mill finish
   4. Components:
      a. Top caps and bottom caps shall be made of injection molded thermoplastics.
      b. Fasteners: All mounting system accessories appropriate for substrates indicated on the drawings shall be provided.
      c. Optional flexible top caps shall be made of injection molded Biopolymer Flex PVC.
   5. Finishes:
      a. Vinyl Covers: Colors of the corner guard to be selected by the architect from the IPC finish selection. Surface shall have a pebblette texture.
      b. Molded Components: Top caps and bottom caps shall be of a color matching the corner guards. Surface shall have a pebblette texture

D. Wall Guard / Crash Rail
   1. Performance Requirements:
      a. Fire Performance Characteristics: Provide UL Classified wall guards conforming with NFPA Class A fire rating. Surface burning characteristics, as determined by UL-723 (ASTM E-84), shall be flame spread of 10 and smoke development of 350 -450. Provide ULC (Canada) listed wall guards conforming to the requirements of the National Building Code of Canada 2010, Subsection 3. 1. 13. Surface burning characteristics, as determined by CAN/ULC-S102. 2, shall be flame spread of 15 and smoke developed of 35.
      b. Self Extinguishing: Provide wall guards with a CC1 classification, as tested in accordance with the procedures specified in ASTM D-635-74, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position, as referenced in UBC 52-4-1988.

c. Impact Strength: Provide rigid vinyl profile materials that have an Impact Strength of 30. 2 ft-lbs./inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics.
d. Chemical and Stain Resistance: Provide wall guards that show resistance to stain when tested in accordance with applicable provisions of ASTM D-543.
e. Fungal and Bacterial Resistance: Provide rigid vinyl that does not support fungal or bacterial growth as tested in accordance with ASTM G-21 and ASTM G-22.
f. Color Consistency: Provide components matched in accordance with SAE J-1545 -(Delta E) with a color difference no greater than 1. 0 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems.

2. Height: 4" high profile
3. Depth: 1" deep profile
4. Materials:
   a. Vinyl: Snap on cover of .080 (2mm) thickness shall be extruded from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers. No plasticizers shall be added.
   b. Aluminum: Continuous aluminum retaininer of .080" (2mm) thickness shall be fabricated from 6063-T5 aluminum, with a mill finish.
5. Components:
   a. End caps, inside corners and outside corners shall be made of injection molded thermoplastics.
   b. Molded reveals shall have a smooth finish and shall be black.
   c. Fasteners: All mounting system accessories appropriate for substrates indicated on the drawings shall be provided.
6. Finishes:
   a. Vinyl Covers: Colors of the wall guard to be selected by the Architect from the manufacturer's full range. Surface shall have a pebblette texture.
   b. Molded Components: End caps, inside corners and outside corners shall be of a color matching the wall guards. Surface shall have a pebble texture.

2.03 FABRICATION

A. Fabricate components with tight joints, corners and seams.

B. Pre-drill holes for attachment.

C. Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Complete all finishing operations, including painting, before beginning installation of handrail or corner guard system materials.

C. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

A. General: Prior to installation, clean substrate to remove dust, debris and loose particles

3.03 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only. Install at all outside corners within area of work.

B. Position top of corridor hand rail at height indicated in Drawings.

C. Position corner guard from top of base to underside of ceiling.

D. Tape On Corner Guard Installation:
   1. Locate handrail as indicated on approved detail drawings.
   2. Surface must be clean, dry and properly sealed.
   3. Installation with factory applied foam tape - Remove release paper from the foam tape.

4. Installation with Heavy Duty Adhesive - Cut the smallest opening possible in the spout. Apply a continuous bead of adhesive on each wing of the corner guard.
5. Position the corner guard on the substrate corner.
6. Starting at the bottom, press into place, working upward until entire corner guard is in place.
7. Roll surface with IPC Extension Roller

E. Hi Impact Corner Guard with Aluminum Retainer
1. Locate handrail as indicated on approved detail drawings.
2. Position the aluminum retainer against the wall, allowing 5/16" (8mm) from the bottom of the aluminum to the top of the cove base or baseboard for the bottom cap.
3. Aluminum Retainer Installation
   a. Drywall installation: Secure the aluminum retainer to the wall using 1-1/4" phillips round head self-tapping screws. Use 6 screws per 4' (1.22m) length, 10 screws per 8' (2.44m) length, or 12 screws per 9' (2.74m) length. The aluminum retainer is pre-slotted to aid in the installation.
   b. Concrete installation: Drill 1/4" holes into the ends of the retainer for top and bottom caps. Use the slotted tabs of the top caps as a template for hole location. Transfer the location of all mounting holes to the wall. Drill 1/4" (6.5mm) holes and position ALLIGATOR anchors into the holes on the wall. Mount the retainer with #10 x 1-3/4" phillips pan head screws and tighten to secure the retainer to the wall.
4. Top and Bottom Cap Installation
   a. Drywall installation: Overlap the aluminum with the mounting tabs of the top cap and attach them to the aluminum retainer using two, 1-3/4" phillips flat head self tapping screws per cap.
   b. Concrete installation: Overlap the aluminum with the mounting tabs of the top and bottom caps and attach them to the aluminum retainer using two, #8 x 1-1/2" phillips flat head screws per cap. When installing flexible top caps on custom angle corner guards, use cup washers and flat head screws to fasten the top caps to the retainer.
5. Position the vinyl cover on the aluminum retainer to check the fit. Adjust the top cap on the aluminum retainer to obtain a tight fit with the vinyl cover. Starting at the top, push the vinyl cover over the aluminum, by pressing over the length until the vinyl snaps securely into place.

F. Corridor Handrail Installation:
1. Locate handrail as indicated on approved detail drawings.
2. Install handrail level and plumb at height indicated on the drawings.
3. Cut the aluminum retainer to the desired length, allowing 3-1/4" (83mm) for each return, 1/4" (6mm) for each outside corner and 4-11/16" (119mm) for each inside corner. Allow 1/4" (6mm) for each 135 degree outside corner and 2-1/16" (52mm) from the corner of the wall for each 135 degree inside corner.
4. Attach returns, inside corners, outside corners and brackets to the aluminum retainer. It is recommended that brackets are installed 4" (102mm) from the ends of a run. Spacing of brackets is recommended to be a maximum of 32" (813mm).
5. Mount the aluminum retainer to the wall using the provided fasteners. Level and secure the aluminum retainer to the wall.
6. Cut the vinyl cover to fit between the returns and/or corners
7. Trim all factory edges square before installation. Position he vinyl cover on the aluminum retainer starting at the top of the retainer and pivoting the vinyl cover over the bottom of the retainer until it snaps into place.

G. Wall Guard / Chair Rail Installation:
1. Locate chair rail as indicated on approved detail drawings.
2. Install chair rail level and plumb at height indicated on the drawings.
3. Cut the aluminum retainer to the desired length allowing 1 7/16" for each end cap and 1 1/2" for each inside corner and 9/16" for each outside corner.

4. Using 1/4" drill bit, drill holes in the centerline of the aluminum retainer 4" from each end and spaced evenly over the entire length per 12' length.
5. Position and level the aluminum retainer on the wall allowing for end caps, inside corners, and outside corners, and transfer mounting holes to the wall with a marker. Drill 1/4" holes at each mark and position the anchors into the holes on the wall. Mount the retainer with manufacturer's recommended fasterners and tigheten to secure the retainer.
6. Slide the end caps, inside corners, outside corners or picture frame corners onto the aluminum leaving a 1/16" gap for adjustments and secure them by using manufacturer's recommended fasteners.
7. Cut the vinyl cover to the distance between the end caps/corners. Position the vinyl cover on the aluminum retainer starting at one end and working ot the other end by pushing the cover onto the aluminum until it snaps in place.

3.04 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch (6 mm).

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

3.05 CLEANING

A. At completion of the installation, clean surfaces in accordance with the IPC clean-up and maintenance instructions.

END OF SECTION

SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Commercial shower and bath accessories.

C. Healthcare accessories.

D. Accessories for toilet rooms, showers, and utility rooms.

E. Diaper changing stations.

F. Utility room accessories.

G. Grab bars.

1.02 RELATED REQUIREMENTS

A. Section 08 8300 - Mirrors:

B. Section 09 3000 - Tiling: Ceramic washroom accessories.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

E. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017.

F. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004, with Editorial Revision (2016).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. AJW Architectural Products; _____: www.ajw.com/#sle.
   2. American Specialties, Inc; _____: www.americanspecialties.com/#sle.
   3. Bradley Corporation; _____: www.bradleycorp.com/#sle.
   4. Bobrick Washrooms Equipment, Inc.; www.bobrick.com.

B. Diaper Changing Stations:
   1. American Specialties, Inc; _____: www.americanspecialties.com/#sle.
   2. Bradley Corporation; _____: www.bradleycorp.com/#sle.
   3. Koala Kare Products; _____: www.koalabear.com/#sle.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.

B. Stainless Steel Sheet: ASTM A666, Type 304.

C. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

D. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

E. Adhesive: Two component epoxy type, waterproof.

F. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

G. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

A. Combination Toilet Paper/Seat Cover Dispenser with Waste Receptacle (Item 9 on the Toilet Accessories Legend): Double roll; Surface-Mounted, stainless steel; seamless wall flanges, continuous piano hinges.
   1. Minimum capacity: 500 seat covers.
   2. Waste receptacle capacity: 0.4 gallons (1.5 liters).
   3. Skirt Material: 18-8, Type-304, heavy-gauge stainless steel. Welded construction. Exposed surfaces have satin-finish.
   4. Flange Material: 18-8, Type-304, 22-gauge (0.8mm) stainless steel with satin-finish. Drawn and beveled, one-piece, seamless construction.
   5. Door Material: 18-8, Type-304, 18-gauge (1.2mm) stainless steel with satin-finish. One-piece, seamless construction Secured to cabinet with a full-length stainless steel piano-hinge. Equipped with a tumbler lock keyed like other Bobrick washroom accessories.
   6. Toilet Tissue Dispensers: 18-8, Type-304, 22-gauge (0.8mm) stainless steel with satin-finish. Equipped with two chrome-plated plastic spindles, each with a heavy-duty internal spring.
   7. Disposal Panel Material: 18-8, Type-304, 22-gauge (0.8mm) stainless steel with hemmed edges; exposed surface has satin-finish. Panel equipped with graphic symbol for waste "drop here". Secured to door with a spring-loaded, full length stainless steel piano-hinge
   8. Waste Receptacle Material: 18-8, Type-304, heavy-gauge stainless steel. All-welded construction. Removable for
   9. Basis of Design Product: Bobrick B-30919 Classic Series Surface-Mounted Toilet Tissue, Seat Cover Dispenser, and Waste Disposal servicing. Capacity: 0.4-gal. (1.5-L).

B. Paper Towel Dispenser (Item 20 on the Toilet Accessories Legend): Folded paper type, stainless steel, surface-mounted, piano hinges, with viewing slots on sides as refill indicator and tumbler lock.
   1. Capacity: 300 C-fold or 400 multi-fold towels minimum.
   2. Cabinet Material: 18-8, Type-304, heavy-gauge stainless steel. All-welded construction. Exposed surfaces have satin-finish
   3. Skirt Material: 18-8, Type-304, stainless steel with satin-finish
   4. Door Material: 18-8, Type-304, 18-gauge (1.2mm) stainless steel with satin-finish. Secured to cabinet with a concealed, full-length stainless steel piano-hinge. Equipped with a tumbler lock keyed like other Bobrick washroom accessories. Tumbler locks flush with the door - no protrusion

5. Paper Towel Dispenser: 18-8, Type-304, 22-gauge (0.8mm) stainless steel. Capacity: 300 C-fold or 400 multifold paper towels. Unit equipped with TowelMate consisting of a 90° return towel guide angle inside cabinet to prevent paper towels from falling forward out when door is opened for servicing.
6. Basis of Design Product: Bobrick B-359039 TrimLine Surface Mounted Paper Towel Dispenser

C. Combination Towel Dispenser/Waste Receptacle: (CTDR) Recessed flush with wall, stainless steel; seamless wall flanges, continuous piano hinges, tumbler locks on upper and lower doors.
1. Towel dispenser capacity: 300 C-Fold or 400 Multifold.
2. Waste receptacle capacity: 1.6 gallons (6.1 liters).
3. Cabinet Material: 18-8, Type-304, heavy-gauge stainless steel. All-welded construction.
4. Door Material: 18-8, Type-304, 18-gauge (1.2mm) stainless steel. 9/16" (14mm) 90° return edges for maximum rigidity. Secured to cabinet with a concealed, full-length stainless steel piano-hinge. Equipped with a stainless steel cable door-swing limiter and friction catch
5. Paper Towel Dispenser: 18-8, Type-304, 22-gauge (0.8mm) stainless steel. Capacity: 300 C-fold or 400 multifold paper towels. Unit equipped with TowelMate consisting of a 90° return towel guide angle inside cabinet to prevent paper towels from falling forward out when door is opened for servicing.
6. Waste Container: Removable, leakproof, rigid molded plastic. Capacity: 1.6-gal. (6.1-L)
7. Basis of Design Product: Bobrick B-36903 Trimine Series Recessed Paper Towel Dispenser/Waste Receptacle

D. Automated Soap Dispenser (Item 28 on the Toilet Accessories Legend): Foaming hand soap and hand sanitizer dispenser, wall-mounted, with stainless steel cover and window to gauge soap level, tumbler lock.
1. Minimum Capacity: 40.5 ounces (1.2 liters).
2. Power Supply: Battery Operated
3. Warranty: Manufacturer's Lifetime Warranty
4. Basis of Design: Georgia Pacific - 52060 EnMotion Gen2 Automatic Touchless Soap & Sanitizer Dispenser by GP Pro, Stainless Finish, 1 Dispenser

E. Soap Dispenser (Item 27 on the Toilet Accessories Legend): Foaming hand soap and hand sanitizer dispenser, wall-mounted, surface, with stainless steel cover and vertical stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
1. Minimum Capacity: 40.5 ounces (1.2 liters).
2. Finish: Brushed Stainless Steel
3. Basis of Design Product: Georgia Pacific - 53060 Pacific Blue Ultra Wall Mounted Manual Dispenser for Foaming Hand Soap and Hand Sanitizer by GP Pro, Brushed Stainless

F. Grab Bars (Items 1, 2, and 3 in Toilet Accessories Legend): Stainless steel, 1-1/2 inches (38 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches (38 mm) clearance between wall and inside of grab bar.
1. Grab bar systems shall meet or exceed the requirements of ANSI Standard A117.1, the ADA and ABA Accessibility Guidelines for Buildings and Facilities (ADAAG), and the Uniform Federal Accessibility Standard (UFAS).
2. Length and configuration: As indicated on drawings.
3. Basis of Design Products: Bradley 812 Series for 42" grab bar, 36" grab bar, and 24" grab bar.

G. Wall Mounted Swing Up Grab Bars (Item 5 in Toilet Accessories Legend): 1-1/4" (32mm) diameter tubing. Satin-Finish, slip-resistant surface stainless steel grab bar for bath/shower/toilet compartment. Exposed mounting.
1. Grab Bar Material: 18-8, Type-304, 18-gauge (1.2mm) stainless steel tubing with satin-fi nish. 1–1/4" (32mm) outside diameter. Ends are heliarc welded to flanges. Non-slip finish.

2. Backplate Material: 18-8, Type-304, 3/16" (5mm) thick, satin-fi nish stainless steel with four screw holes for attachment to wall.
3. Weight Capacity: 1,000lb for bariatric use.
4. Basis of Design Product: Bobrick 4998 Swing Up Grab Bar

H. Decorative Grab Bars (Items 6, 7, and 8 in Toilet Accessories Legend): 1-1/4" (32mm) diameter tubing grab bar
1. Material: Brushed Stainless Steel
2. Meets ADA and ICC/ANSI A117.1
3. Basis of Design Product: Kohler Purist
   a. Kohler Purist 11897-S for 48" grab bar.
   b. Kohler Purist 11896-S for 42" grab bar.
   c. Kohler Purist 11895-S for 36" grab bar.

I. Diaper Changing Station (Item 16 on the Toilet Accessories Legend): Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
1. Style: Horizontal.
2. Bacterial-Resistant High Density Plastic with brushed 20 gauge Stainless Steel exterior
3. Mounting: Surface.
4. Maximum Holding Capacity: 250 lbs static load, tested to 390 lbs.
5. Pneumatic gas shock mechanism to ensure smooth, safe open and close motion
6. Corner Guards: Black nylon 6/6 corner guards for added protection.
7. Molded Dual Liner Dispenser: holds approx. 50 per dispenser
8. Safety Belt: with cam-buckle, adjustable with one hand.
9. Unit includes built in purse/diaper bag hook.
10. Basis of Design: Bradley Corporation Model 962-11 Stainless Steel Baby Changing Station

2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES

A. Shower Curtain Rod (Item 25 on the Toilet Accessories Legend): Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 3 inch (75 mm) outside diameter, minimum 0.04 inch (1.0 mm) thick satin-finished stainless steel flanges, for concealed mounting.
1. Material: 20-gauge (1.0mm), type 304 stainless steel, satin finish.
2. Flange: 1 3/8″ (35mm) diameter flanges are chrome-plated plastic, bright-polished finish
3. Concealed Mounting Brackets: Aluminum
4. Length: As required for full length of shower.
5. Basis of Design: Bobrick B-207 Shower Curtin Rof with Concealed Mounting

B. Shower Curtain (Item 25 on the Toilet Accessories Legend): Hookless Shower Curtain
1. Material: Polyester, non-woven, anti-microbial, water repellent, machine washable, and mildew-resistant.
2. Size: As necessary to provide full coverage of opening in which curtain is installed.
   a. Curtain shall be sized 6" wider than the openings up to 42" and 12" wider than openings exceeding 42".
3. Grommets: 2-piece, rolled-edge, rustproof nickel-plated brass & spaced not more than 6" (150mm) OC
4. Ultrasonic bottom hem with magnetic weights
5. Complies with NFPA 701
6. Warranty: Manufacturer's one year warranty
7. Basis of Design: CS Group 100% Polyester Mystery White Fabric with Sheer Window and Vinyl Liner

C. Folding Shower Seat (Item 24 on the Toilet Accessories Legend): Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, reversible, right hand or left hand as designated in Drawings seat.

1. Frame Material: Type 304 (18-8) S.S. tubing, 1-1/4" (32mm) x 18 ga. (1.2mm) sq. main frame with 1" (25mm) x 18 ga. (1.2mm) rd. cross members
2. Wall Flange Material: Type 304 (18-8) S.S., 10 ga. (3.4mm) x 3" (76mm) Dia. Hellarc welded to 1" (25mm) rd. x 18 ga. (1.2mm) 90-degree leg supports, and to 1-1/4" (32mm) rd. x 12 ga. (2.7mm) frame hinge couplings. Three mounting holes in each flange
3. Swing Down Leg Material: “H” Shaped yoke of type 304 (18-8) S.S. 1" Dia. (25mm) x 18ga. (1.2mm) rd. tubing, heliarc welded to 1-1/4" (32mm) rd. x 12 ga. (2.7mm) frame hinge couplings.
4. Seat: One-piece, pan-type, 0.05 inch (1.3 mm) stainless steel sheet, Type 304. Weld seams and grind smooth.
5. Size: ADA Standards compliant.
6. Basis of Design Product: Bobrick B-51815 Reversible Seat with Swing Down Legs

D. Towel Bar (Item 18 on the Toilet Accessories Legend): Stainless steel, 3/4 inch (20 mm) square tubular bar; rectangular brackets, concealed attachment, satin finish.
1. Length: 24 inches (610 mm).
2. Material: Zinc, Stainless Steel
3. Finish: Vibrant Brushed Nickel
4. Basis of Design Product: Kohler Square K-23285-BN

E. Robe Hook (Item 17 on the Toilet Accessories Legend): Heavy-duty stainless steel, double-prong, surface mounted bracket and backplate for concealed attachment, satin finish.
1. Material: Zinc, Stainless Steel
2. Finish: Vibrant Brushed Nickel
3. Basis of Design: Kohler Square K-23290-BN

2.06 HEALTHCARE ACCESSORIES

A. Specimen Pass-Through Cabinet (Item 19 on the Toilet Accessories Legend):
1. Mounts in walls 3″ to 5 3/4″ (75-145mm) thick.
2. Cabinet Material: 18-8, type-304, 22-gauge (0.8mm) stainless steel. All-welded construction. Exposed surfaces have satin finish. Two slots located on top and bottom for mounting.
3. Flange Material: 18-8, type-304, 22-gauge (0.8mm) stainless steel with satin finish. Drawn and beveled, one-piece, seamless construction. One mounting tab with screw hole located on top and bottom.
4. Door Material: 18-8, type-304, 18-gauge (1.2mm) stainless steel with satin finish. Each door is spring-loaded and secured to cabinet with a full-length stainless steel piano-hinge. Doors equipped with cast-aluminum pull knob, interlocking mechanism, and international graphic symbol identifying specimen cabinet.
5. Spillage Tray Material: 18-8, type-304, 24-gauge (0.6mm) stainless steel. All-welded construction.
6. Doors shall be self-closing and have interlocking mechanism to prevent both doors from being open at the same time. Doors shall have full lengh stainless steel piano hinges.
7. Spillage tray shall be removable.
8. International graphic symbol on doors shall identify specimen cabinet.
9. Basis of Design: Bobrick B-505 Recessed Specimen Pass-Thru Cabinet

B. PPE Dispensers
1. Automatic Hand Sanitizer Dispenser (Item 26 on the Toilet Accessories Legend): Wall mounted
   a. Capacity: One 1200mL hand sanitizer dispenser, refillable, with coin cell battery integrated into the refill.
   b. Touch-free
   c. Requires "C" cell batteries, no tools required for replacing
   d. Unit shall be able to be locked
   e. Basis of Design: Purell ES8 Hand Sanitizer Dispenser - White

2.07 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder (Item 29 on the Toilet Accessories Legend): 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.
   1. Mounting Base and Shelf: 18-8, type-304, 18-gauge (1.2mm) stainless steel with satin finish. All-welded construction. Shelf is 8" (205mm) deep with 3/4" (19mm) return edge on all three sides. Front edge is hemmed for safety.
   2. Shelf Support Brackets: 18-8, type-304, 16-gauge (1.6mm) stainless steel with satin finish. Welded to mounting base and shelf.
   3. Mop/Broom Holders: Spring-loaded rubber cams with anti-slip coating. Plated steel retainers.
   4. Hooks: 18-8, type-304, 12-gauge (2.8mm) stainless steel with satin finish. Each hook attached to mounting strip with two rivets.
   5. Hooks: 4, 0.06 inch (1.6 mm) stainless steel rag hooks at shelf front.
   6. Mop/broom holders: 3 spring-loaded rubber cam holders at shelf front.
   7. Length: Manufacturer's standard length for number of holders/hooks.
   8. Basis of Design Product: Bobrick B-239 Utiltiy Shelf with Mop/Brook Holder and Rag Hooks

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

D. Mounting Heights and Locations: As required by accessibility regulations

END OF SECTION

SECTION 10 4116 - EMERGENCY KEY CABINETS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Emergency key cabinets and supplementary items necessary for installation.

1.02 SUBMITTALS

A. Product Data: Manufacturer’s technical literature for each product and system indicated.
   1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.

B. Samples for Verification Purposes: 3 in (75 mm) square sample of exposed metal to indicate compliance with finish specified.

1.03 QUALITY ASSURANCE

A. Local Authority Approval: Obtain approval of local fire department for keyway access and exact location and type of emergency key cabinet mounting prior to Product Data submittal.

B. Emergency key cabinet will be required at building entrance(s) designated by the fire department or at the building's fire control room; as appropriate.

1.04 COORDINATION

A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
   1. Knox Company.

2.02 MATERIALS, GENERAL

A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.03 EMERGENCY KEY CABINET

A. Product Standard: Knox Company “Knox-Box” 3200 Series Hinged or Lift-Off Door Model, as required by local jurisdiction. 1/4 in (6 mm) thick steel plate housing, 1/2 in (12 mm) thick steel door with interior gasket seal and stainless steel door hinge. Box and lock shall be UL Listed.
   1. Lock shall have 1/8 in (3 mm) thick stainless steel dust cover with tamper seal mounting capability.
   2. Lock shall have double-action rotating tumblers and hardened steel pins accessed by a biased cut key.
   3. Coordinate other necessary requirements with local fire department.
   4. Provide UL Listed alarm tamper switches as required by local fire department.

B. Size: One of the following, recessed or surface mount; as indicated on drawings:
   1. Recessed Mount: 7 in (175 mm) wide by 7 in (175 mm) high by 3 in (75 mm) deep.
      a. Provide manufacturer’s standard recessed mounting kit (RMK) including shell housing and mounting hardware for cast-in construction.
   2. Surface Mount: One of the following as required by local jurisdiction:
      a. Hinged Door Model: 5 in (125 mm) wide by 4 in (100 mm) high by 3-3/4 in (94 mm) deep.
      b. Surface Mount - Lift-Off Door Model: 4 in (100 mm) wide by 5 in (125 mm) high by 3-3/4 in (94 mm) deep.

C. Finish: Manufacturer’s standard weather resistant polyester powder coat.

1. Color: As selected by Architect from manufacturer’s standard colors.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.02 INSTALLATION, GENERAL

A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
   1. Respective manufacturer’s written installation instructions.
   2. Accepted submittals.
   3. Contract Documents.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.03 PREPARATION

A. General: Comply with manufacturer’s instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.04 INSTALLATION OF EMERGENCY KEY CABINETS

A. Install in accordance with manufacturer's latest published requirements.

B. Recess Mount Units: Securely attach recessed mounting kit within cast-in wall construction. Shell housing box shall be flush with face of finished wall and plumb and level to ensure vertical alignment of box.

C. Tamper Switches: Install switches, including control wiring, as follows:
   1. Refer to Division 16 Sections for connection to electrical power distribution system.
   2. Coordinate tamper switches with building security system.

END OF SECTION

SECTION 10 4400 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide; current edition.

B. NFPA 10 - Standard for Portable Fire Extinguishers; 2017.

C. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

C. Product Data: Provide extinguisher operational features, color and finish, and anchorage details.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

1.05 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. Ansul, a Tyco Business; Cleanguard: www.ansul.com/#sle.
   2. JL Industries, Inc: a division of Activar Construction Products Group.
   3. Larsen's Manufacturing Co; www.larsensmfg.com.
   4. Potter-Roemer; www. potterroemer.com
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Fire Extinguisher Cabinets and Accessories:
   1. Ansul, a Tyco Business: www.ansul.com/#sle.
   2. JL Industries, Inc: www.jlindustries.com.
   3. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
   4. Potter-Roemer: www.potterroemer.com/#sle.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C type.
   2. Size: 10 pound (4.54 kg).
   3. Finish: Baked polyester powder coat, red color.
   4. Temperature range: Minus 40 degrees F (Minus 40 degrees C) to 120 degrees F (49 degrees C).

C. Wet Chemical Type Fire Extinguishers - for use at Kitchens: Stainless steel tank, with pressure gage.
   1. Class: K type.
   2. Size: 1.6 gallons (6 L).
   3. Temperature range: Minus 20 degrees F (Minus 29 degrees C) to 120 degrees F (49 degrees C).

2.03 FIRE EXTINGUISHER CABINETS

A. Metal: Formed stainless steel sheet; 0.036 inch (0.9 mm) thick base metal.

B. Cabinet Configuration: Semi-recessed type.
   1. Size to accommodate accessories.
   2. Trim: Flat rolled edge, with 2-1/2 inch (____ mm) wide face.
   3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.

C. Door Glazing: Tempered glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.

D. Weld, fill, and grind components smooth.

E. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.

F. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

A. Cabinet Signage: As required by local building officials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

C. Examine walls and partitions for suitable framing depth and blocking where recess and semirecssed cabinets will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare recesses for recessed and semirecessed fire extinguisher cabinets as required by type and size of cabinet and trim style.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, 60 inches (____ mm) from finished floor to top of cabinet, unless otherwise indicated in drawings.

C. Fasten cabinets to structure, square and plumb.
   1. Where indicated or at locations required when installed in fire-rated wall assemblies by wall construction, provide recessed fire extinguisher cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire extinguisher cabinets.
   2. Fasten mounting brackets to inside surface of fire extinguiser cabinets, square and plumb.

D. Place extinguishers in cabinets.

3.04 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire extinguisher cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire extinguisher cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire extinguisher cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire extinguisher cabinets that cannot be restoreed to factory-finished appearance. Use only materials and procedures recommended or furnished by fire extinguisher cabinet and mounting bracket manufacturers.

E. Replace fire extinguisher cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or simlar minor repair procedures.

END OF SECTION

SECTION 10 5100 - LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Plastic Laminate Locker units with hinged doors.

B. Locker benches.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood blocking and nailers

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 QUALITY ASSURANCE

A. All parts and hardware shall be AWI compliant,structurally sound and free from defects, in material and workmanship under normal use and service for the full warranty period

1.05 SUBMITTALS

A. Product Data: Manufacturer's published data on locker construction, sizes and accessories.

B. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.

C. Samples: Submit two samples 4 by 4 inches (102 by 102 mm) in size, of each color scheduled.

D. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in a dry, ventilated area until ready for installation.

B. Protect locker finish and adjacent surfaces from moisture, soiling, and damage.

1.07 PROJECT CONDITIONS

A. Maintain environmental conditions(temperature, humidity, and ventilation) within limitsrecommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer’s absolute limits.

B. During and after installation, maintain same temperature and humidity conditionsin building spaces as will occur after occupancy.

C. Protect locker finish and adjacentsurfacesfrom damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Plastic Laminate Lockers:
   1. Basis of Design Product: Subject to compliance with requirements, provide the products listed below. Specific lockers identified below are to establish the color, design intent, and required standard of quality. It is not the intent to preclude the use of other prior approved, acceptable manufacturers.
   2. Basis of Design Product: Hollman Inc.; 1825 Walnut Hill Lane, Irving, TX 75038, ph: 800-433-3630, Fax: 972-815-2921, email: lockers@hollman.com.
      a. Model Z style plastic laminate lockers.
   3. Ideal Products, Inc: www.idealockers.com.
   4. Or prior approved equal.

2.02 LOCKER APPLICATIONS

A. Lockers: Double tier lockers with z-configuration, wall mounted.
   1. Locations: As Indicated in Drawings
   2. Width: 15 inches
   3. Locker Depth: 18 inches
   4. Locker Height: 72 inches

5. Fittings: Heavy Duty 1" diameter chrome Coat Rod and Heavy Duty 3" high, 7/8" wide 2 1/2 inch deep single prong hanging hook.
6. Lockable Compartments: Main doors
7. Locks: Basis of Design - Hollman Digilock Next Sola
8. Latching: Cremone handle
9. Wood-look laminate to be selected from manufacturer's full range.
10. Provide number disc
11. Provide sloped top.
12. Provide 5% ADA Compliant Lockers. Consult Architect for location if not indicated in the Drawings.

2.03 PLASTIC LAMINATE LOCKERS

A. Lockers: Factory assembled, made of particleboard core panels with mortise and tenon joints and stainless steel mechanical joint fasteners; fully finished inside and out; each locker capable of standing alone.
   1. Double Tier Z-configuration, locations as indicated in drawings
   2. Visible Edges: Sealed with a 1.5 millimeter PVC edge banding to closely match locker doors
   3. Doors: Laminate, Full overlay, covering full width and height of locker body; square edges.
      a. 5/8" high-industrial grade particle board core with .030 inch vertical grade high pressure Class II-B fire retardant plastic laminate. Matching laminate applied to interior and exterior door face.
      b. Door edges sealed with eased edge 1.5mm PVC edge banding to closely match laminate.
   4. Where locker ends or sides are exposed, finish the same as fronts or provide extra panels to match fronts.
   5. Ventilation: 12 millimeter openings between door and top and bottom of locker and dividers on multiple opening frames to provide continuous natural air flow.
   6. Door Color: To be selected by Architectfrom manufacturer's full range.
   7. Body Color: To be selected by Architect from manufacturer's full range.
   8. Fasteners for Accessories and Locking Mechanisms: Tamperproof type.

B. Plastic Laminate Panels: High pressure laminate, Class II-B fire-retardant, VGS-GP28, 3/4 inch standard particleboard, UL & HPMA.

C. Hinges: Euro-concealed, 6 way adjustable, 110 degree opening, self-closing, nickel plated, lifetime guarantee.
   1. 3 hinges per door 36" - 59" H
   2. 2 hinges per door 35" H and under

D. Coat Hooks: Stainless steel; attached with tamperproof screws.
   1. 2 prong metal hooks

E. Coat Rod: Stainless steel, attached with tamperproof screws.
   1. 1" diameter recessed rod.

F. Number Plates: Manufacturer's standard, minimum 4-digit, permanently attached with adhesive; may be field installed.

G. Locks: Basis of Design: Hollman Digilock Next Sola; Center vertically in door and space horizontally per lock type manufacturer's recommendations.
   1. Electronic Locking system to allow shared and assigned use functionalities.
   2. Keypad Interface
   3. Surface Mounting
   4. Brushed Nickel finish.
   5. Cylinder Length as required for locker to function as intended.
   6. ADA Compliant
   7. FCC, IC, and CE Certified
   8. IP55 Rated to withstand dust and moisture

9. Provide override key.

2.04 FABRICATION

A. Lockers shall be fabricated using doweled and glued & nailed assembly process.

B. Fabricate lockers square, rigid, and without warp, with finished faces flat and free of scratches and chips.

C. Machine all parts and attachment holes accurately and without chips.

D. Fabricate corners, fillers, scribes, tops as required for installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until adjacentsubstrates and finishes have been properly prepared.

B. Verify that prepared bases are in correct position and configuration.

C. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfacesthoroughly prior to installation.

B. Prepare surfaces using the methodsrecommended by the manufacturerfor achieving the best result for the substrate under the project conditions.

C. Verify adequacy of backing and support framing.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Set and secure lockers in place. Install lockers rigid, plumb, level, and square.

C. Use concealed joint fasteners to align and secure adjoining cabinet units.

D. Conceal screw heads with plastic caps to match locker interior.

E. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 lb (445 N).

F. Bolt adjoining locker units together to provide rigid installation.

G. Install end panels, filler panels, and sloped tops as indicated on the approved shop drawings.

H. Install accessories.

I. Replace components that do not operate smoothly.

3.04 ADJUSTING

A. Adjust moving or operating parts to function smoothly and correctly.

3.05 CLEANING

A. Clean locker interiors and exterior surfaces.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair, or replace products before Substantial Completion.

END OF SECTION

SECTION 10 7113 - EXTERIOR SUN CONTROL DEVICES

PART 1- GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section covers Kawneer Aluminum Sunshade Systems, including accessories, mountings, and shims. Sunshades are anchored directly to the vertical and/or horizontal mullions.

B. Basis of Design: Types of Kawneer Sunshades include:
   1. Versoleil® SunShade Horizontal Single Blade System compatible with:
      a. 1600 Wall System®1 Curtain Wall System

C. Related Sections:
   1. 07 9200: Joint Sealants
   2. 08 4113: Aluminum-Framed Entrances and Storefronts
   3. 08 4413: Glazed Aluminum Curtain Walls
   4. 08 8000: Glazing

1.03 DEFINITIONS

A. For fenestration industry standard terminology and definitions, refer to the Fenestration & Glazing Industry Alliance (FGIA) Glossary (AAMA AG-13).

1.04 PERFORMANCE REQUIREMENTS

A. Structural Performance:
   1. Combined load on sunshade configurations to be determined in accordance with ASCE 7 or applicable code requirements. Combined load consists of wind, snow and ice loads.
   2. Design sunshade configurations to withstand stresses due to combined load. Stresses resulting from thermal expansion/contraction, shall not cause permanent deformation of sunshade assemblies or disengagement from the glazed system.
   3. The assembled sunshade shall be capable of supporting the specified combined load without damage, permanent deformation, or disengagement from the glazed system mullion.
   4. Blade deflection shall not exceed L/120 of span length.
   5. Submit test reports verifying compliance with each test requirement required by the project.

B. Shading Performance:
   1. Design shall allow for one-time adjustment of the aerofoil blade angle and size to optimize the shading performance based on project location, latitude, altitude, building orientation, surrounding conditions, and aesthetic requirements.
      a. Blades shall be capable of orientations of:
         1) Horizontal sunshade configurations: Clockwise is positive and anti-clockwise negative 0°, -5°, -10°, -15°, -20°, -25°, -30°, and -35°.

C. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures.
   1. Temperature Change (Range): 120 deg F (49 deg C), ambient; 180 deg F (82 deg C), material surfaces.

D. Environmental Product Declaration (EPD): Shall have a Type III Product-Specific EPD.

1.05 SUBMITTALS

A. Product Data:
   1. For each type of product indicated, include:
      a. Construction details
      b. Material descriptions
      c. Dimensions of individual components and profiles

d. Finishes
2. Recycled Content:
a. Provide documentation that aluminum has a minimum of 50% mixed pre- and post-consumer recycled content.
b. Provide a sample document illustrating project-specific information that will be provided after product shipment.
c. After product has shipped, provide project-specific recycled content information:
1) Indicate recycled content, including the percentage of pre- and post-consumer recycled content per unit of product.
2) Indicate the relative dollar value of recycled content product to the total dollar value of product included in the project.
3) Indicate the location for recovery of recycled content.
4) Indicate the location of the manufacturing facility.
3. Environmental Product Declaration (EPD):
a. Include a Type III Product-Specific EPD.
4. Material Ingredient Reporting:
a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.

B. Shop Drawings:
1. Plans
2. Elevations
3. Sections
4. Blade angles
5. Blade spacing
6. Attachments to other compatible systems work

C. Samples for Initial Selection:
1. Provide samples for units with factory-applied color finishes.
2. Provide samples of hardware and accessories involving color selection.

D. Samples for Verification:
1. Provide a verification sample for each type of exposed finish required, in manufacturer's standard sizes.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer must have successfully installed the same or similar systems required for the project and other projects of similar size and scope.

B. Manufacturer Qualifications:
1. Manufacturer shall have a minimum of three (3) years experience in the manufacturing of the product system.
2. Manufacturer of sunshade devices shall be the same as the manufacturer of the storefront and curtainwall systems.

C. Source Limitations:
1. Obtain aluminum exterior sunshades and glazed aluminum curtain walls and storefront system through one source from a single manufacturer.

D. Product Options:
1. Information on drawings and in specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Mockups:

1. Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

F. Pre-installation Conference:
1. Conduct conference at project site to comply with requirements in Division 01 Project Management and Coordination Section.

1.07 PROJECT CONDITIONS

A. Field Measurements:
1. Verify actual locations of structural supports for sunshades by field measurements before fabrication.
2. Indicate measurements on shop drawings.

1.08 WARRANTY

A. Submit manufacturer's standard warranty for owner's acceptance.

B. Warranty Period:
1. Two years from Date of Substantial Completion of the project provided however that in no event shall the Limited Warranty begin later than six months from date of shipment by manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product:
1. Kawneer Company, Inc.
a. Versoleil® Single Blade Horizontal Sunshade, 10 inch bladesize, set at 0 degree angle as indicated in Drawings.
2. Oldcastle Building Envelope
3. YKK AP America Inc
4. Or Prior Approved Equal

2.02 MATERIALS

A. Aluminum Extrusions:
1. Alloy and temper recommended by glazed aluminum curtain wall and storefront manufacturer for strength, corrosion resistance, and application of required finish
2. Not less than 0.070" (1.8 mm) wall thickness at any location for the main frame
3. Complying with ASTM B221: 6063-T6 alloy and temper
4. Recycled Content:
a. Shall have a minimum of 50% mixed pre- and post-consumer recycled content.
b. Indicate recycled content, including the percentage of pre- and post-consumer recycled content per unit of product.
c. Indicate the relative dollar value of recycled content product to the total dollar value of product included in the project.
d. Indicate the location for recovery of recycled content.
e. Indicate the location of the manufacturing facility.

B. Thermal Barrier:
1. When applied on a thermally broken captured system, sunshade shall be thermally isolated from the interior aluminum mullions by a nominal 0.25" (6.3) thick low conductance material.

C. Aluminum Sheet Alloy:
1. Shall meet the requirements of ASTM B209.

D. Sealant:
1. For sealants required within fabricated sunshade system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

E. Tolerances:

1. References to tolerances for wall thickness and other cross-sectional dimensions of glazed curtain wall and storefront members are nominal and in compliance with AA Aluminum Standards and Data.

F. Red List Free:
   1. All parts and materials comply with the Living Building Challenge/DECLARE Red List and the Cradle-to-Cradle (C2C) Banned List:
      a. PVC-free
      b. Neoprene-free
   2. Product does not contain PVC or Neoprene.

2.03 SUNSHADES

A. Sunshade Members:
   1. Manufacturer's standard extruded or formed-aluminum framing members of thickness and reinforced as required to support imposed loads.

B. Fasteners and Accessories:
   1. Nonmagnetic stainless steel to be non-corrosive and compatible with aluminum members, anchors, and other components.

C. Perimeter Anchors:
   1. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

D. Packing, Shipping, Handling, and Unloading:
   1. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

E. Storage and Protection:
   1. Store materials so that they are protected from exposure to harmful weather conditions.
   2. Handle material and components to avoid damage.
   3. Protect material against damage from elements, construction activities, and other hazards before, during, and after installation.

2.04 ACCESSORY MATERIALS

A. Bituminous Paint:
   1. Cold-applied asphalt-mastic paint
   2. Complies with SSPC-Paint 12 requirements except containing no asbestos
   3. Formulated for 30-mil (0.762 mm) thickness per coat

2.05 FABRICATION

A. Extrude or form aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations
   2. Accurately fitted joints that are flush, hairline, and weatherproof
   3. Physical and thermal isolation of glazing from framing members
   4. Accommodations for thermal and mechanical movements of glazing and framing that maintain required glazing edge clearances
   5. Fasteners, anchors, and connection devices that are concealed from view to the greatest extent possible

C. Sunshade:
   1. Fabricate components for assembly using manufacturer’s standard installation instructions.

D. After fabrication, clearly mark components to identify their locations in project according to shop drawings.

2.06 ALUMINUM FINISHES

A. Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:
   1. Kawneer Permafluor™ (70% PVDF), AAMA 2605, Fluoropolymer Coating
      a. Color as Selected by Architect from Manufacturer's Full Range

PART 3 - EXECUTION

3.01 EXAMINATION

A. With installer present, examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

B. Proceed with installation only after correcting unsatisfactory conditions.

3.02 INSTALLATION

A. General:
   1. Comply with manufacturer's written instructions. Refer to installation instructions of the compatible curtain wall or storefront system.
   2. Do not install damaged components.
   3. Fit joints to produce hairline joints free of burrs and distortion.
   4. Rigidly secure non-movement joints.
   5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
   6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
   7. Seal joints watertight where shown on approved shop drawings and/or manufacturer's standard installation instructions.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components plumb and true in alignment with established lines and grades.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.03 ADJUSTING, CLEANING, AND PROTECTION

A. Adjusting: Not applicable.

B. Protection:
   1. Protect installed product’s finish surfaces from damage during construction.
   2. Protect aluminum sunshade system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants

C. Cleaning:
   1. Repair or replace damaged installed products.
   2. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance.
   3. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
   4. Remove construction debris from project site and legally dispose of debris.

END OF SECTION

SECTION 10 7300 - EXTRUDED ALUMINUM CANOPIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The bidding documents, General Conditions, Supplementary Conditions, drawings and requirements of Division One specifications shall apply to Work specified in this Section.

1.02 DESCRIPTION OF WORK

A. Work is this Section includes extruded aluminum walkway covers, overhead hanger rod supported, as indicated in drawings.

B. Definition: Extruded Aluminum Canopy shall consist entirely of extruded aluminum sections (roll-formed not acceptable). System shall consist of heli-arc welded, one-piece rigid structural bents (beam assemblies), decking, fascia, accessory items and hardware to provide a complete system.

C. Water shall drain from deck into designated beams and out at grade level of columns through weepholes.

D. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering walkway covers by employing qualified professional engineer, registered to practice in the state of Louisiana, to prepare design calculations, shop drawings, and foundation details to withstand hurricane force winds as indicated in structural drawings. Engineer shall reference Geotechnical Report as included in the project specifications manual.

1.03 SUBMITTALS

A. Shop Drawings: Submit detailed drawings, layout of canopy system, bent locations (identify drain columns and wet bents), all mechanical joint locations with complete details, connections, jointing and accessories. Include details of concrete footings and bent anchorage.

B. Product Data: Submit manufacturer's product data, specifications, component performance data and installation instructions.

C. Calculations: Provide signed and sealed structural calculations for the proposed walkway cover, and foundation by a professional engineer registered in the state of Louisiana, who professes his discipline to be structural engineering.

1.04 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following except as otherwise indicated:
   1. International Building Code, latest edition with amendments, if any.
   2. AWS (American Welding Society) standards for structural aluminum welding.

B. Manufacturer: Obtain aluminum covered walkway system from only one (1) manufacturer, although several may be indicated as offering products complying with requirements.

C. Installer Qualification: Firm with not less than three (3) years experience in installation of aluminum walkway covers of type, quantity and installation methods similar to work of this Section.

D. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to ensure proper fitting of work. However, allow for adjustments within specified tolerations wherever taking of field measurements before fabrication might delay work.

E. Shop Assembly: Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

F. Coordination: Coordinate Work of this Section with work of other sections which interface with covered walkway system (sidewalks, curbs, building fascias, fencing, etc.)

1.05 PERFORMANCE REQUIREMENTS

A. System Performance: Provide extruded aluminum canopy system that has been designed, produced, fabricated and installed to withstand normal temperature changes as well as live

loading, dead loading and wind loading in compliance with International Building Code requirements for geographic area in which work is located and as follows:
1. Live Load: As indicated on structural drawings.
2. Structural design for wind forces: Comply with ANSI A58.1-1982
3. Design Wind Velocity: As indicated on structural drawings.
4. Importance Factor: As indicated on structural drawings.

B. Sizes shown on drawings are to be considered minimum.

C. Structure shall be capable of sustaining severe hail, hurricane force winds and supporting a concentrated load such as being walked upon.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following manufacturers:
1. **Basis of Design**: Perfection Architectural Systems, Inc.; www.perfectionarch.com.
2. Mapes Architectural Canopies - Super Lumideck Extruded, Lincoln, Nebraska, 1.888.273.1132; www.mapes.com.
3. DITT-Deck Extruded Aluminum Walkway Cover System by Dittmer Architectural Aluminum.
4. Peachtree Protective Covers; www.peachtreecovers.com.
5. Or prior approved equal.

B. Equivalent systems by other manufacturers will be approved by Addendum provided the following are submitted fourteen (14) days prior to bid opening and are complete:
1. Submit evidence of having operated a successful business of manufacturing and installing complete extruded aluminum walkway cover systems.
   a. Business must have been in operation under submitted name and ownership for a minimum of ten (10) years.
   b. Submit a list of successfully completed projects of similar scope, size and complexity within the state of Louisiana. List shall include job name, date of completion, architect's firm name and contact information, Owner's name with representative and contact number.
   c. Comply with the requirements pertaining to substitution as set forth in Instructions to Bidders and Division One Section 016000 - Product Requirements.

2.02 MATERIALS

A. All aluminum extrusions shall be alloy 6063 heat treated to a T-6 temper.

B. Standard finish for all components shall be 2-coat Kynar finish. Color to be selected by Architect from manufacturer's full range.

C. Columns:
1. Radius-cornered aluminum tubular extrusion, size as required by manufacturer structural engineering design.
2. Grout Key: Provide two 1-1/2 inch diameter holes in column base, one each in opposite sides.
3. Provide clear acrylic protection coat on surfaces in contact with grout.

D. Beams: Open top aluminum tubular extrusions.
1. Size and Profile: As required by manufacturer's structural engineering design.
2. Provided welded endplate water dams where sections terminate at other than drainage channels.

E. Fascia: Manufacturer's standard extruded aluminum fascia sections as required to complete the installation resulting in a neat finished appearance.
1. Include manufacturer's standard extruded aluminum gutters.

F. Fasteners:

1. Deck Screws (rivets not permitted): Type 18-8 non-magnetic stainless steel sealed with neoprene "O" ring beneath 5/8" outside dimension, conical washer.
2. Fascia Rivets: Size 3/16" by 1/2" grip range aluminum rivets with aluminum mandrel.
3. Bolts: All bolts, nuts and washers to be 18-8 non-magnetic stainless steel.
4. Tek Screws: not permitted.
5. Other Fasteners: Type 18-8 stainless steel, type recommended by manufacturer for specific condition.
6. Hanger Rods and Attachements: Shall be sized as per manufacturer's recommendations and engineered calculations.

G. Warranty:
1. Manufacturer shall warrant the entire system against defects in labor and materials for a period of one (1) year commencing on the date of Substantial Completion as established in Division One of these Specifications.
2. Intention of this warranty is that the manufacturer will come onto the jobsite and do all necessary to effect corrections of any deficiencies
3. Prima Fascia Evidence of defects in labor and material may include but is not limited to, one or more of the following:
   a. Moisture leaks
   b. Metal failure including excessive deflection.
   c. Fastener failure
   d. Finish failure

2.03 FABRICATION

A. Comply with indicated profiles, dimensioned requirements and structural requirements.

B. Use sections true to details with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, free from defects impairing strength and durability.

C. All welding to be done by heli-arc process.

D. Bents shall consist of shop welded one piece units. When size of bents do not permit shipment as a welded unit, concealed mechanical joints may be used.

E. Mechanical joints shall consist of stainless steel bolts with a minimum of two (2) bolts per fastening. Bolts and nuts shall be installed in a concealed manner utilizing 1/2" thick by 1 1/2" aluminum bolt bars welded to structural members. All such mechanical joints must be detailed on shop drawings showing all locations.

F. Roof Deck: Extruded Aluminum shapes, interlocking self-flashing sections. Shop fabricate to lengths and panels widths required for field assembly. Depth of sections to comply with structural requirements. Provide shop induced camber in deck units with spans greater than 16'-0" to offset dead load deflections. Welded dams are to be used at non-draining ends of deck.

G. Expansion joints, design structure for thermal expansion and contraction. Provide expansion joints as required.

H. Exposed rivets used to fasten bottom of fascia to deck to have finish to match fascia.

I. Apply a shop applied dip-coat of clear acrylic enamel to each column end terminating in concrete to insulate from electrolytic reaction. Column ends shall be pierced to "key" grout to bent for maximum uplift protection.

PART 3 EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle covered walkway system components as recommended by manufacturer. Handle and store in a manner to avoid deforming members and to avoid excessive stresses.

3.02 EXAMINATION

A. Examine adjacent work for conditions that would prevent quality installation of system.

B. Do not proceed until defects are corrected.

3.03 CONCRETE FOOTINGS

A. Concrete footings are to be part of the Work of this Section.

B. Sleeves (styrofoam blockouts) shall be furnished and installed by walkway cover manufacturer & installer.

3.04 FIELD DIMENSIONS

A. General Contractor shall field confirm bent locations, dimensions and elevations shown up on shop drawings prior to fabrication.

3.05 INSTALLATION

A. Erection: Set roof support frames (bents) into pockets provided in top of footings; set to required elevations, align, plumb and level; and grout in place with 2,000 psi Portland cement grout. Assure that grout fills all voids and "keys" to columns. Fill downspout units with grout to bottom of discharge level. Install aluminum deflectors after grouting. Follow manufacturer's instructions. Match to finish and elevation of adjacent sidewalks.

B. Install roof deck sections, accessories and related flashing in accordance with manufacturer's instructions. Provide roof slope for rain drainage without ponding water. Align and anchor roof deck units to structural support frames.

C. Assemble all components in a neat, workmanlike manner.

3.06 FLASHING

A. Flashings: Flashings required between covered walkway system and adjoining structures are not work of this Section. Refer to "Sheet Metal Flashing and Trim", Section 076200.

3.07 CLEANING AND PROTECTION

A. Damaged Units: Replace roof deck panels and other components of the Work which have been damaged or have deteriorated beyond successful minor repair.

B. Cleaning: Remove protective coverings at time in project construction sequence which will afford greatest protection of Work. Clean finished surfaces as recommended by manufacturer. Maintain in a clean condition during construction.

C. Protection: Advise Contractor of protection and surveillance procedures, as required to ensure that Work of this Section will be without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 11 1319 - STATIONARY LOADING DOCK EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Loading dock lifts (scissors lifts).

B. Maintenance.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete pad.

1.03 REFERENCE STANDARDS

A. ANSI MH29.1 - Safety Requirements for Industrial Scissors Lifts; 2012.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures

B. Product Data: Provide materials and finish, installation details, roughing-in measurements, and operation of unit and safety lock device.

C. Shop Drawings: Indicate required opening dimensions and tolerances, perimeter conditions of construction, placement dimensions of safety lock devices, and diagrams for power, signal, and control wiring.

D. Manufacturer's Installation Instructions: Indicate special requirements.

E. Manufacturer's Qualification Statement.

F. Installer's Qualification Statement.

G. Operation Data: Provide operating instructions, and identify unit limitations.

H. Maintenance Data: Provide unit maintenance information, lubrication cycles, and spare parts manual.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 FIELD CONDITIONS

A. Existing Conditions: Field verify dimensions of construction related to stationary loading dock equipment prior to fabrication, including recessed pit dimensions, slope of inclined dock approach, dock height, and height and width of dock door openings.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer agrees to correct defective work within two year period from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Loading Dock Lifts (Scissors Lifts):

1. Basis of Design: Blue Giant Equipment Corporation; Lowmaster Dock Lift Series: www.bluegiant.com.
2. Advance Lifts, Inc.
3. Pentalift, Inc.
4. Or prior approved equal.

2.02 LOADING DOCK LIFTS (SCISSORS LIFTS)

A. Loading Dock Lifts: Provide manufacturer92s standard loading dock scissors lifts, in compliance with ANSI MH29.1 requirements, and of capacity, size, and construction as indicated, consisting of a nonslip steel platform with beveled toe guards on each side, steel scissors legs, and hydraulic operating system, complete with controls, safety devices, approach ramp, and required accessories.
   1. Type: Stationary, double leg set, hydraulic dock lift designed for a permanent, fully recessed installation at location(s) as indicated on drawings.
      a. Recessed Concrete Pit: Provide preformed concrete pit sized to fit dimensions of specified dock lifts.
      b. Ensure concrete slab is reinforced as required to support surface mounted dock lifts.
      c. Refer to Section 03 3000 for additional cast concrete requirements.
   2. Rated Lifting Capacity: 10,000 lbs (3629 kg), minimum.
   3. Vertical Travel Distance: Provide maximum vertical travel of 59 inch (1854 mm) up from floor level.
   4. Construction: Provide structural steel shapes rigidly welded and reinforced for maximum strength, safety, and stability.
      a. Provide assembly that withstands deformation during both operating and stationary phases of service.
   5. Platform: Fabricate platform using heavy checkered steel plate with beveled toe guards on each side, and in compliance with ANSI MH29.1 requirements.
      a. Platform Size: 72 inch wide by 96 inch long (1.8288 m wide by 2.4384 m long), nominal.
   6. Railing: Steel pipe, 1-1/2 inch (38 mm) diameter, with top rail, one intermediate horizontal rails, and uprights at 48 inches (1220 mm) on center, maximum; threaded joints; steel anchor plates.
   7. Hinged Bridge: Provide hinged, throw-over bridge, with heavy-duty piano-type hinge welded to toe guard at end of platform.
      a. Provide heavy-duty lifting chains for bridge.
      b. Chamfer edge of bridge to minimize obstruction of material-handling vehicles wheels.
      c. Bridge Material: Non-skid, safety-tread steel plate.
   8. Scissors Mechanism: Fabricate leg members from heavy, steel formed tubes to provide maximum strength and rigidity.
   9. Cylinders: Provide lift with at least two heavy-duty, high-pressure, hydraulic, ram-style cylinders.
      a. Direct-displacement plunger type rams with positive internal stops as standard by manufacturer.
      b. Provide chrome plated and polished cylinder rods to prevent rusting.

B. Operation: Provide manufacturer's standard, self-contained, electric, hydraulic power unit for raising and lowering lift, controlled from a remotely located push-button station.
   1. Electrical Requirements: Coordinate wiring requirements and current characteristics with building electrical system.
   2. Power Unit: Provide manufacturer's standard, self-contained, remotely located power unit of size, type, and necessary operation for specified lift capacity; power unit to consist of total enclosed, fan-cooled (TEFC) motor, high-pressure gear pump, valve manifold and oil reservoir.
      a. Motor Voltage/Amperage: As required by manufacturer for specified system; single phase.
      b. Provide manifold with relief valve, check valve, pressure-compensated flow-control valve and solenoid valve.
      c. Speed Control: Provide manufacturer's standard pressure-compensated flow-control to maintain rated speed when lift is loaded or unloaded.

d. Free-Fall Protection: Provide hydraulic velocity fuse at each cylinder to prevent lift platform from free falling in the event of a severed hydraulic hose or broken hydraulic fitting.
e. Provide manual lowering valve located on power pack in case of power loss.

3. Remotely Located Control Station: Provide weatherproof, multi-button control station, constant-pressure type for up and down push buttons, with Type 4X rated enclosure in accordance with NEMA 250.
   a. Provide controller with magnetic motor starter and having three pole-adjustable overloads and 115 VAC control transformer with a fused secondary pre-wired to terminal strips, with Type 12 rated enclosure in accordance with NEMA 250.
   b. Safety Devices: Provide manufacturer's standard safety devices as required for specified scissors lift application in accordance with ANSI MH29.1 requirements.

C. Finish: Manufacturer's standard paint applied to factory-assembled and tested dock scissors lifts prior to shipment.
   1. Color of Surfaces: Manufacturer's standard color.
   2. Color of Toe Guards: Paint with yellow and black stripes.

2.03 FINISHES

A. Metal Plate Platform: Hot dip galvanized to 1.25 oz/sq ft finish (Hot dip galvanized to 380 gm/sq m finish).

B. Frame: Factory enameled finish.

C. Railing: Factory enameled finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine loading dock equipment area for compliance with requirements for installation tolerances and other conditions related to this work.

B. Examine rough-in for electrical systems of loading dock equipment to verify openings and locations are acceptable prior to installation of equipment.

C. Proceed with installation after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare loading dock equipment for size and locations as indicated, and provide anchoring devices with templates, diagrams, and installation instructions.

3.03 INSTALLATION

A. Install loading dock leveler unit in prepared opening in accordance with manufacturer's written instructions.
   1. Set square and level.
   2. Anchor unit securely, flush with dock, and weld back of leveling dock to pit frame; touch-up welds with primer.
   3. Install electrical connections as required for fully operational system.

B. Install equipment pad for loading dock scissors lifts to ensure it is level, and can accomodate lift in proper relation to loading platform.
   1. Anchor loading dock scissors lift securely in place, in accordance with manufacturer92s written instructions.
   2. Install electrical connections as required for fully operational system.

3.04 ADJUSTING

A. Adjust installed loading dock equipment and safety devices for smooth and balanced operation, and lubricate as recommended by manufacturer.

B. Test dock levelers for vertical travel within operating range as indicated, and adjust as necessary for proper operation.

C. After installation, inspect exposed factory finished loading dock equipment, and repair damaged finishes.

3.05 MAINTENANCE

A. Provide service and maintenance of operating equipment for a period of one year from Date of Substantial Completion.
   1. Includes monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation of loading dock equipment at rated speed and capacity.
   2. Provide manufacturer's authorized replacement parts and supplies.

END OF SECTION

SECTION 11 4000 - FOODSERVICE EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foodservice equipment.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between equipment and adjacent walls, floors, and ceilings.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

B. FM (AG) - FM Approval Guide; current edition.

C. NSF 2 - Food Equipment; 2019.

D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

E. National Electrical Code (NEC)

F. American Gas Association (AGA)

G. Louisiana State Board of Health

H. Occupational Safety and Health Administration (OSHA)

I. National Fire Protection Association (NFPA)

J. International Building Code (IBC)

K. American Disabilities Act (ADA)

1.04 DESCRIPTION OF WORK

A. Furnishing, delivery, un-crating, setting in place at locations indicated on Drawings, leveling, adjusting and cleaning all equipment specified herein.

B. Apply permanent foot/caster placement markings to building floor at all cooking equipment requiring coverage of fire suppression system in accordance with NFPA-96 codes.

C. All components required for a complete assembly to serve intended function when connected to mechanical and electrical services.

D. Coordination of all Work required for a complete installation with other trades and subcontractors.

E. Field verification of plumbing and electrical rough-ins by Food Service Equipment Contractor to ensure requirements and locations are correct. Said verification shall include all electrical characteristics (amperage, voltage, and phase) for all Existing, Contractor-Furnished, and Owner-Furnished Equipment. Field verification shall commence prior to release of equipment order and pouring of concrete slab by General Contractor.

F. Sink faucets, strainers, vacuum breakers, duo drains, lever handle drains and tailpieces specified under heading entitled Fabrication Standards.

G. Cutting of all holes in equipment tops, shelves and bodies required for piping (gas, water and drains) and wiring.

1.05 RELATED WORK SPECIFIED ELSEWHERE

A. Water/gas piping, line shut-off valves and final connections to equipment.

B. Drain piping, floor drains, floor sinks, “P” traps, grease traps and final connections to equipment.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on appliances; indicate configuration, sizes, materials, finishes, locations, and utility service connection locations, service characteristics, and wiring diagrams.

C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of standard products of the type specified.

B. Food Service Equipment Contractor Qualifications:
   1. Contractor shall possess experience and ability to perform the necessary services for a complete and workmanlike installation of food service equipment.
   2. Contractor experience shall include a minimum of five (5) years' experience as a successful Food Service Equipment Contractor and shall have successfully completed installation of at least five (5) comparable projects of similar size and nature.
   3. Contractor's in-house capabilities shall include preparation of dimensioned mechanical/electrical rough-in Drawings, experienced personnel to coordinate with other trades the proper equipment installation, warranty services, and proper demonstration of equipment on operation, service and maintenance.

C. All equipment shall be constructed in strict compliance with standards of National Sanitation Foundation and shall bear the NSF label. All equipment shall meet all standards set by state and local regulations.

D. All material shall be new (latest model at time of delivery) and of first quality. All equipment shall be installed in an undamaged condition. Where brands, materials, apparatus or equipment is specifically designated, no substitution shall be made without prior approval in writing.

E. Provide all Work in best manner in conformity with best standard practices. Employ qualified, efficient and skillful workers for installation in a first-class manner.

F. It is required that custom fabricated equipment be fabricated by a Food Service Equipment Fabricator who has plant, personnel and engineering facilities to design, detail and manufacture high quality equipment.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store products clear of floor in a manner to prevent damage.

B. Coordinate size of access and route to place of installation.

C. Contractor shall at all times cover and protect his Work, material and equipment to save same from damage. Contractor shall at all times exercise due care to protect the work of others. Cost of any repair or replacement of damaged Work, material and equipment shall be borne by Contractor.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work of this section within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Foodservice Equipment:
   1. Custom Fabricated Equipment Manufacturers: All fabricated equipment shall be manufactured by one (1) manufacturer to ensure uniformity in design and finish.
      a. Low Temp Industries, Inc.
      b. Atlanta Custom Fabricators
      c. Stainless & Aluminum Fabrication.
      d. Or Prior Approved Equal

2.02 EQUIPMENT

A. Equipment Schedule: Refer to schedule at end of this section.

B. Installation Accessories: Provide rough-in hardware, supports and connections, attachment devices, closure trim, and accessories as required for complete installation.

2.03 MATERIALS

A. Stainless Steel Sheet: ASTM A666 Type 304 commercial grade with 18% chromium, 8% nickel and maximum of 0.12% carbon, No. 4 finish.

B. Welding: All welded parts shall be non-porous and free from imperfections, pits, cracks or discolorations. Stainless steel joints and seams shall be heli-arc welded ground smooth and polished to a No. 4 finish. Tinning of welds is not acceptable. All welds shall be ground smooth and polished to original finish of metal.

C. Field Joints: Field joints shall be located for practical construction with sizes convenient for shipping and entry into building spaces. All field joints shall be fully (continuous) welded with same type metal, ground smooth and polished to original finish of metal.

D. Table and Counter Tops:
   1. All tops, unless otherwise specified, shall be constructed of 14-gauge stainless steel. Exterior edges not adjacent to walls or other equipment shall be turned down on a 90-degree angle or rolled down 1-3/4" with corners bullnosed. Tops adjacent to walls shall be turned up 6" and back 1" (minimum) on a 90-degree angle to form a backsplash. Tops adjacent to other equipment shall be flanged straight down 1-3/4". Sound deadening material shall be provided between frame members and stainless steel tops.
   2. Edges of dishtable tops not adjacent to walls shall be turned up 3" and rolled down 1-1/2" with corners bullnosed. Dishtable tops adjacent to walls shall be turned up 10", back 2-1/2" on a 45-degree angle and down 2" to form a pipe chase. All horizontal edges and internal corners of dishtable tops shall be coved on a 5/8" minimum radius. Ends of backsplashes shall be closed, welded, ground smooth and polished.
   3. Edges of preparation counter tops (with sinks) not adjacent to walls shall be turned up 7/8" on a 45-degree angle and turned down on a 90-degree angle or rolled down 2-5/8" to form a marine roll unless specified otherwise. Preparation counter tops (with sinks and cantilevered overshelf uprights) adjacent to walls shall be turned up 10", back 2-1/4" on a 45-degree angle and turned down 1" on 90-degree angle to form a backsplash with pipe chase. All horizontal edges and internal corners of preparation counter tops shall be coved on a 5/8" minimum radius. Ends of backsplashes shall be closed, welded, ground smooth and polished. Backsplashes of counter tops with sinks shall be pierced on 8" centers over sinks.
   4. All tops shall be reinforced on the underside with 12-gauge (minimum) stainless steel hat channels running from front to back with center bracing where required to hold tops flat. Channels shall be stud welded and bolted to underside of tops with legs, bodies and drawer housings secured to channels so that bolts or rivets will not extend through work tops. Holes required for counter equipment shall be neatly die-punched with raised edges

E. Backsplashes:
   1. Backsplashes of table and countertop with 90-degree turnbacks adjacent to walls shall be turned down 1" at 90-degrees and secured to building walls with 4" long 14-gauge stainless steel "zee" clips on 36" centers. Cracks between backsplashes and building walls shall be sealed with clear silicone sealant.
   2. Backsplashes of preparation counters and dishtables with 45-degree turnbacks adjacent to walls shall be turned down 1" at 135-degrees and secured to walls with 4" long 14-gauge stainless steel "zee" clips on 36" centers. Cracks between backsplashes and building walls shall be sealed with clear silicone sealant.

F. Open Bases:
   1. Open bases shall be constructed of 1-5/8" OD 16-gauge stainless steel tubular uprights and crossbraces fully welded together, ground smooth and polished. Top of crossbraces

shall be 12" above floor. Refer to Drawings for arrangement of crossbraces. Uprights shall be fitted at floor with adjustable, sanitary stainless steel bullet feet inserted into uprights with inside threads to eliminate any possibility of threading collecting dirt and other matter. Tops of legs shall be fitted into die-stamped fully enclosed stainless steel gussets equivalent to Component Hardware No. A20-0206 welded to reinforcing channels on underside of stainless steel tops.

2. Tables 6' 0" long and under shall have four (4) legs, and tables 7'-0" long shall have six (6) legs. Legs shall be spaced not more than 5' 0" apart unless specified otherwise

G. Undershelves:
   1. All undershelves shall be constructed of 18-gauge stainless steel.
   2. Undershelves on open base tables shall be sectional, removable and rolled down over crossbraces, unless specified in Itemized Equipment Specifications. Shelves adjacent to walls and other equipment shall turn up 2". Shelves shall be notched around table uprights and crossbraces, so that undershelves are easily removable. All edges of sections adjacent to each other shall be turned down 1" (minimum) for rigidity.

H. Elevated Shelves:
   1. Elevated shelves shall be constructed of 16-gauge stainless steel and shall be turned down 1-1/2" on front and ends with sanitary semi-rolled edges with bullnosed corners. Rear sides of shelves shall be turned up 1-1/2".
   2. Free-standing shelves, unless specified otherwise, shall be mounted on 1" OD stainless steel tubular uprights mounted to counter tops in a sanitary manner (tube inserts when accessible from bottom of counter). Wall mounted shelves shall be equipped with stainless steel angle wall brackets anchored to building wall.
   3. Shelves, where specified to be mounted on cantilever brackets, shall be mounted on 1-5/8" diameter stainless steel tubular uprights welded to framing of table and counter tops.

I. Sinks:
   1. Sinks shall be constructed of 14-gauge stainless steel having back, bottom and front formed of one (1) continuous sheet of metal with ends and partitions welded in place. All vertical and horizontal corners of sink compartments shall be coved with metal on a 5/8" (minimum) radius. No solder filleting will be acceptable. All edges of sink counter tops not adjacent to walls shall be turned up 7/8" on a 45-degree angle, and rolled down 2-5/8" to form a marine roll unless specified otherwise. Edges of sink counter tops adjacent to wall shall be turned up 10", back 2-1/4" on a 45-degree angle and down 2" to form a backsplash with pipe chase. All ends of backsplashes shall be closed, ground smooth and polished. Backsplashes shall be pierced on 8" centers over compartment dividers of two, three and four compartment sinks and over center of one compartment sinks unless specified otherwise. Bottom of each sink compartment shall be fitted with Component Hardware No. D50-7200 lever handle drain. Overflow drain assemblies when specified shall be Component Hardware No. D50-7215. Drains shall set into embossed openings in sink bottoms, gasketed and locked in place without use of rivets or bolts. Sinks shall be mounted on 1-5/8" OD 16-gauge stainless steel legs with adjustable stainless steel feet (same as specified for open base tables). All sink partitions shall be 7/8" thick double wall construction. Sinks shall be 12" deep unless specified otherwise.
   2. Faucet shall be mounted at center of each sink compartment sink and over each partition of each multiple compartment sink. Faucets shall be as specified in the Plumbing Drawings. Contractor to coordinate for a complete and working system.
   3. Sink inserts shall be constructed same as specified for sinks above with coved corners and 2" lever drains. Sink inserts shall be welded integral with stainless steel tops. Inserts unless otherwise specified, shall have a T & S model no. B-0222-059X faucet deck-mounted behind each compartment

2.04 FABRICATION

A. Install rubber button feet on bearing surface of any item positioned on a finished surface.

B. Isolate rotating or reciprocating machinery to prevent noise and vibration.

C. Provide indirect drain piping from equipment to terminate over nearest waste receptor.

D. Accommodate site installation of other services or equipment.

2.05 FINISHES

A. Stainless Steel: No. 4 finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify ventilation outlets, service connections, and supports are correct and in required location.

B. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install items in accordance with manufacturers' instructions.

B. Insulate to prevent electrolysis between dissimilar metals.

C. Weld and grind joints in steel work tight, without open seams, where necessary due to limitations of sheet sizes or installation requirements.

D. Sequence installation and erection to ensure correct mechanical and electrical utility connections are achieved.

E. Use anchoring devices appropriate for equipment and expected usage.

3.03 ADJUSTING

A. Adjust equipment and apparatus to ensure proper working order and conditions.

B. Remove and replace equipment creating excessive noise or vibration.

3.04 CLEANING

A. Remove masking or protective covering from stainless steel and other finished surfaces.

B. Wash and clean equipment.

C. Polish glass, plastic, hardware, accessories, fixtures, and fittings.

3.05 CLOSEOUT ACTIVITIES

A. At completion of work, provide qualified and trained personnel to demonstrate operation of each item of equipment and instruct Owner in operating procedures and maintenance.
   1. Test equipment prior to demonstration.

3.06 PROTECTION

A. Remove protective coverings from prefinished work.

B. Protect finished work from damage.

3.07 FOODSERVICE EQUIPMENT SCHEDULE

A. Preparation Counter w/Sink (One Required):
   1. Location: Sterile Pack SG-5009
   2. 24" deep x full length of wall opening (approx. 9'-6" long, v.i.f.) x 34” high, arrangement indicated on drawings, custom fabricated stainless steel open base type with components/features/accessories as follows:
      a. Marine roll top edges on front and right end
      b. One (1) 18” x 18” x 12” deep sink
      c. 10" High rolled backspash full length opening and sides.
      d. Splash-mount faucet (provided in Plumbing Scope, Contractor to coordinated for complete and working system)
      e. Undershelves, except at sinks
      f. Elevated Shelf (Overshelf), 15" deep x full length of wall opening (approx. 9'-6" long, v.i.f), mounted at height indicated in Interior Elevation
      g. Elevated Shelf (Overshelf), 15" deep x 4'-0" long, mounted at height indicated in Interior Elevation

h. Footworks No. 9401-B-L-1/2 pedal valve with stainless braided hose kit

B. Preparation Counter w/Sink (One Required):
   1. Location: Decontam SG-5006
   2. 24" deep x full length of wall opening (approx. 6'-4" long, v.i.f.) x 34” high, arrangement indicated on drawings, custom fabricated stainless steel open base type with components/features/accessories as follows:
      a. Marine roll top edges on front and right end
      b. One (1) 18” x 18” x 12” deep sink
      c. 10" High rolled backspash full length opening and sides.
      d. Splash-mount faucet (provided in Plumbing Scope, Contractor to coordinated for complete and working system)
      e. Undershelves, except at sinks
      f. Elevated Shelf (Overshelf), 15" deep x full length of wall opening (approx. 6'-4" long, v.i.f), mounted at height indicated in Interior Elevation
      g. Footworks No. 9401-B-L-1/2 pedal valve with stainless braided hose kit

END OF SECTION

SECTION 11 5200 - MOTORIZED PHOTO SCREENS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Motorized Retractable Photo Backdrop

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Supports for motorized screens.

B. Section 06 1000 - Rough Carpentry: Wood blocking in walls and ceilings.

C. Section 09 2116 - Gypsum Board Assemblies: Suspended gypsum board ceilings for recessed screens, and openings in gypsum board partitions for motorized screens.

D. Section 09 5100 - Acoustical Ceilings: Suspended panel ceilings for recessed screens.

E. Section 26 0583 - Wiring Connections: Electrical supply, conduit, and wiring for electric motor operated projection screens.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's catalog cuts and descriptive information on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Wiring diagrams for motor operators and actuators, and controls and switches.

C. Samples: For screen fabrics, submit two samples 6 by 6 inch (152 by 152 mm) in size.

D. Samples: For case and frame finishes, submit two samples 6 by 6 inch (152 by 152 mm) in size, illustrating color and texture of finish.

E. Manufacturer's Qualification Statement.

F. Operation and Maintenance Data: Provide manufacturer's operation and maintenance instructions.

G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver screens to project site in manufacturer's original unopened packaging, and inspect for damage and proper size before accepting delivery.

B. Store in a protected, clean, dry area with temperature maintained above 50 degrees F (10 degrees C), and stack in accordance with manufacturer's recommendations.

C. Acclimate screens to building temperatures for 24 hours prior to installation, in accordance with manufacturer's recommendations.

1.06 FIELD CONDITIONS

A. Maintain interior of building between 60 degrees F (15 degrees C) and __ degrees F (__ degrees C) during and after installation of projection screens.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide 1 year manufacturer warranty for screen and screen assembly.

PART 2 PRODUCTS

2.01 MOTORIZED RETRACTABLE PHOTO BACKDROP

A. Manufacturers:
   1. BadgePlus; Product: BadgePlus Motorized Retractable Photo Backdrop: www.badgeplus.com.
   2. Or Prior Approved Equal.

B. Provide Remote Switching: Infrared remote option with three button remote and a wall switch to lower, retract, and stop the backdrop.

C. Size: 4'-0" W x 10'-0" H screen

D. Screen Material: Seamless Reinforced fabric with durable laminated backing.

E. Backdrop Screen Color: Light Blue

F. Casing Material: Powder coated aluminum

G. Casing: White

H. Bracket Extension: White

I. Installation: Recessed into Ceiling

J. Provide two (2) #6 6-inch wall brackets for retractable photo backdrop at each location.

K. Motor: 120V

L. Bearings: Nylon

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is finished and ready to accept screen installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that openings for recessed screens are correctly sized.

D. Verify type and location of electrical connections.

E. Do not install screens until climate control systems are in place and interior painting and other finishes are completed.

3.02 PREPARATION

A. Coordinate installation with adjacent construction and fixtures, including ceilings, walls, lighting, fire suppression, and registers and grilles.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, using manufacturer's recommended hardware for relevant substrates.

B. Do not field cut screens.

C. Install screens in mountings as specified and as indicated on drawings.

D. Install plumb and level.

E. Adjust screens and related hardware in accordance with manufacturer's instructions for proper placement and operation.

F. Test electrical screens for proper working condition. Adjust as needed.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 12 2200 - PLEATED DRAPERY

PART 1 GENERAL

1.01 SUMMARY

A. Provide Pleated Drapery for Decoration and Light Control

1.02 SECTION INCLUDES

A. Pinch Pleat Drapery

1.03 RELATED WORK

A. Rough carpentry for wood blocking and support grounds

B. Miscellaneous metal for framing and reinforcing

1.04 REFERENCES

A. National Fire Protection Association (NFPA)

1.05 PERFORMANCE REQUIREMENTS

A. Provide Pleated Drapery that conform to the following requirements of regulatory agencies and the quality control of Inpro Corporation.

1. Fire Performance: Provide drapery fabrics that conform with NFPA 701 Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

1.06 SUBMITTALS

A. Product Data: Manufacturer's printed product data for each type of Pleated Drapery specified.

B. Detail Drawings: Mounting details with the appropriate fasteners for wall or ceiling condition.

C. Samples: Verification samples of drapery fabric samples.

D. Manufacturer's Installation Instruction: Printed installation instructions for Pleated Draperies.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in unopened factory packaging to the jobsite.

B. Inspect materials at delivery to assure that specified products have been received.

C. Store in original packaging in a climate controlled location away from direct sunlight.

1.08 PROJECT CONDITIONS

A. Environmental Conditions: Products must be installed in an interior climate controlled environment.

1.09 WARRANTY

A. Standard Inpro Corporation Limited One-Year Warranty against manufacturing and material defect.

B. Fabric Warranty: 3 years

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Basis of Design Drapery System: Juniper Commercial Window Treatments, a Division of Inpro Corporation; Product: Clickeze Pinch Pleat Draperies, Cord Operated Ceiling Mounted Track System: www.inprocorp.com

B. Basis of Design Fabric: Carnegie Fabrics, Deltacoustic 101125-63

2.02 FABRICATION

A. Specifications for Pleated heading system consist of the following:

1. Pleated drapery style:
2. Pinch Pleat Drapery
   a. Pleated drapes contain pin on hooks that slide into carriers attached to drapery rods.

b. 4" permanent buckram finished heading, 4" bottom hems and 1-1/2" side hems. Bottoms and side hems are double turned and blind stitched with matching polyester thread.
c. Headings will usually cover the face of the track (architectural track styles)
d. Weighted corners. 1” covered lead weights sewn inside hem at each vertical seam and corners as standard. For sheer or lightweight fabric, it is recommended to use continuous sausage weights.
e. Operator: Hidden Clip-on Baton, Bolt-on Baton or Cord Draw (indicate left or right).
f. Vertical Seams: 3/8” lap stitch. Where patterned fabrics are used, it is recommended to specify the pattern is sewn with the repeat for best appearance.
g. If less than a full width of fabric is required to accomplish the specified fullness, all partial widths shall be located at the stack back end of each drapery panel.
h. Drapery Fullness: 100% Fullness, 0.55 NRC
i. Height of drapery to be Full Height, 1” above finished floor.
j. Fabric Basis of Design: Carnegie Deltaacoustic 101125-63
    1) Contents: 100% Trevira CS Polyester
    2) PVC Free
    3) Color as Specified in Finish Key
    4) Weight per Linear Yard: 12.1 oz
    5) Acoustics:
        (a) NRC when draped flat: 0.4
        (b) NRC when draped at 100% fullness: 0.55

B. Drapery Hardware
    1. Assembled sets shall be provided, complete with all the components required, to sustain imposed loads and to perform the functions shown for the respective locations.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates, adjoining construction and conditions under which the work is to be installed. The work shall not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Install drapery with hardware in accordance with manufacturer's recommendations.
    1. Attach bracket to wall or ceiling. Brackets are to be at each end of track. Install one bracket 24" from each drapery stacking end. Space remaining brackets at 48" intervals over the remainder of the track. Adjust wall bracket to the required distance from the wall with the bracket length adjustment screw.
    2. Lift track to the brackets and attach track to the bracket by turning the silver locking cam with a screwdriver until it grips the track.
    3. If not pre-assembled:
        a. Insert slides/carriers into track.
        b. Attach pulley set or end caps to track.
    4. For pre-assembled, remove extra carriers, if any were included. If assembling on-site, only include the required amount. Extra carriers can inhibit drapery operation.

B. Hang drapery so that the top of the heading clears the ceiling above by 1/4 in. and the bottom hem clearance is a maximum of 1 in. from the finished floor or 1/2 in. from the sill line, unless otherwise noted.

C. Drapery shall be free of creases and wrinkles after hanging and shall be steamed and dressed down as required.

3.03 PROTECTION

A. Protect drapery from soiling or damage after hanging.

END OF SECTION

SECTION 12 2400 - ROLLER WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Window shades and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

B. Section 09 2116 - Gypsum Board Assemblies: Substrate for window shade systems.

C. Section 09 5100 - Acoustical Ceilings: Shade Pockets, pocket closures and accessories.

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of all affected installers.

B. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken.
   2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3300 - Submittal Proceduers, for submittal process.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details.

D. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

E. Selection Samples: Include fabric samples in full range of available colors and patterns.

F. Verification Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.

G. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

I. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum five years of documented experience.
   1. Factory training and demonstrated experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.08 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: Ten years.
   2. Aluminum and Steel Coatings: Ten years.
   3. ShadeCloth: Twenty-Five years

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manually Operated Roller Shades (**WT-1, WT-2**): At all exterior windows not designated to receive motorized roller shades.
   1. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com/#sle.
   2. TimberBlindMetroShade; SolarVue Manual Roller Shade: www.altawindowfashions.com.
   3. SWFcontract, a division of Springs Window Fashions, LLC.; _____: www.swfcontract.com/#sle.
   4. Basis of Design: MechoShade Systems, Inc..
   5. Substitutions: See Section 01 6000 - Product Requirements.

B. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 WINDOW SHADE APPLICATIONS

A. Refer to plans for shade types and locations.
   1. Type (**WT-2**): Single Roller Shade
      a. Basis of Design Fabric: Mecho ThermoVeil with 3% Open
      b. Color: As indicated in Finish Key, or as selected by Architect from manufacturer's full range of colors.
      c. Mounting: Per details in Drawings.
      d. Operation: Manual.
      e. Fascia: To match adjacent window system.
      f. Location: At all windows in offices and other locations as indicated in Drawings.
   2. Type (**WT-1**): Dual Roller Shade.
      a. Fabric 1: Mecho Chelsea Blackout.
      b. Fabric 2: Mecho ThermoVeil with 3% Open
      c. Color: As indicated in Finish Key, or as selected by Architect from manufacturer’s full range of colors.
      d. Mounting: Per details in Drawings.
      e. Operation:
         1) Manual
      f. Location: At all windows at In-Patient Rooms, in Conference Rooms, and other locations as indicated in Drawings.

2.03 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
   1. Bead Chains: Nickel-plated metal.
      a. Loop Length: Extend to within 36 inches above finished floor.
      b. Limit Stops: Provide upper and lower ball stops.
      c. Chain-Retainer Type: Chain tensioner, sill-mounted or mounted on vertical window mullion, as applicable.
   2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.

a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
   1. Roller Drive-End Location: Right side of inside face of shade, unless otherwise indicated on Drawings.
   2. Direction of Shadeband Roll: Regular, from back of roller.
   3. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Shadebands:
   1. Shadeband Material: Light-filtering fabric.
   2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
      a. Type: Enclosed in sealed pocket of shadeband material.

E. Installation Accessories:
   1. Wall-Mount Angle Support Angles: Manufacturer's standard design for support of concealed roller window shade operating mechanism to be installed above finish ceiling as indicated on the Drawings.

2.04 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Black-out Shade Fabric:
   1. Source: Roller-shade manufacturer.
   2. Type: 50% Acrylic Coating and 50% Polyester
   3. Roll Width: Maximum available by manufacturer, but not less than 84 inches.
   4. Openness Factor: Opaque
   5. Colors: As indicated in Finish Key or as selected from Manufacturer's Full Range.
   6. Fabric shall be capable of railroading.
   7. Fire Classification: NFPA 701
   8. Mesh Weight: 11.5 oz/ sq yd
   9. Fabric Thickness: 0.018 inch

C. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
   1. Source: Roller-shade manufacturer.
   2. Type: PVC-coated polyester, unless otherwise indicated in the Drawing “FINISH KEY.”
      a. 75% PVC (coating), 25% Polyester (yarn)
   3. Roll Width: Maximum available by manufacturer, but not less than 84 inches.
   4. Openness Factor: 3 percent, unless otherwise indicated in the Drawing “FINISH KEY.”
   5. Colors: As Indicated in Finish Key or as selected from Manufacturer's Full Range
   6. Fabric shall be capable of railroading.
   7. Fire Classification: NFPA 701
   8. Bacterial and Fungal Resistance: ASTM G21 & ASTM E2180
   9. Acoustic Performance:
      a. NRC: 0.25
      b. SAA: 0.25
   10. Mesh Weight: 20 oz/ sq. yd
   11. Fabric Thickness: 0.036 inch

2.05 ACCESSORIES

A. Fascias: Size as required to conceal shade mounting.

1. Style: As selected by Architect from shade manufacturer’s full selection.
2. Material and Color: To be selected by Designer from shade manufacturer's full range.

B. Brackets and Mounting Hardware: As recommended by manufacturer for mounting configuration and span indicated.

C. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.06 FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Fabricate shades to fit openings within specified tolerances.
1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch (13 mm) space between bottom bar and window stool.
2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.

C. Dimensional Tolerances: As recommended in writing by manufacturer.

D. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Installation Tolerances:
1. Maximum Offset From Level: 1/16 inch (1.5 mm).

C. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.

D. Adjust level, projection and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

3.06 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 3600 - SIMULATED STONE COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Wall-hung counters and vanity tops.

1.02 RELATED REQUIREMENTS

A. Section 06 4100 - Architectural Wood Casework.

B. Section 09 2116 - Gypsum Board Assemblies - Non-structural metal framing.

1.03 REFERENCE STANDARDS

A. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

B. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.

C. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

D. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.

E. PS 1 - Structural Plywood; 2009.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures, for submittal process.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

F. Installation Instructions: Manufacturer's installation instructions and recommendations.

G. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS AND WINDOW STOOLS

A. Solid Surfacing Materials **(SSM-1)**: Solid surfacing sheet or plastic resin casting over continuous substrate. To be used for countertop and window stool applications as indicated in Drawings.
   1. Flat Sheet Thickness: 1/2 inch (12 mm) at countertop areas, and 3/4 inch at window stools, unless otherwise indicated on Drawings.

2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
    a. Manufacturers:
        1) Staron: www.staron.com
        2) Dupont; Corian: www.corian.com.
        3) Basis of Design (SSM-1): Wilsonart; 9196RS Yukon Riverstone: www.wilsonart.com/#sle.
        4) Or prior approved equal.
    b. Color and Pattern: As selected by Architect from manufacturer's full line, unless indicated on Drawing Finish Key.
3. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high, unless otherwise indicated.

B. Natural Quartz and Resin Composite Countertops and Wall Panels: Sheet or slab of natural quartz and plastic resin over continuous substrate.
1. Flat Sheet Thickness: 3/4 inch (20 mm), minimum.
2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard stone fabrication tools; no surface coating; color and pattern consistent throughout thickness.
    a. Manufacturers:
        1) Cambria Company LLC; ____: www.cambriausa.com/#sle.
        2) Dal-Tile Corporation; ____: www.daltile.com/#sle.
        3) Basis of Design (QS-1): Wilsonart; Q4045 Homoa: www.wilsonart.com.
        4) Basis of Design (QS-2): Wilsonart; [Q4036 Coastal]: www.wilsonart.com.
        5) Basis of Design (QS-13: Wilsonart; [Q1023 Gardar Basalt]: www.wilsonart.com.
    b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with NSI (DSDM).
    c. Finish on Exposed Surfaces: Polished.
3. Other Components Thickness: 3/4 inch (19 mm), minimum.
4. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.

2.02 MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.

B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

C. Joint Sealant: Mildew-resistant silicone sealant, clear, unless indicated otherwise.

2.03 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
1. Join lengths of tops using best method recommended by manufacturer.
2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
2. Height: 4 inches (102 mm), unless otherwise indicated.

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches (3657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match counterop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
2. Seal edges of cutouts in particleboard subtops by saturating with varnish.

B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

C. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 8 feet (3 mm in 2.4 m), maximum. 1/4 inch (6mm) maximum. Do not exceed 1/64 inch (0.4mm) difference between planes of adjacent units.

B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.

C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Specialty valves.
4. Sprinklers.
5. Alarm devices.
6. Control panels.
7. Pressure gages.

B. FURNISH ALL MATERIALS, LABOR, TOOLS, EQUIPMENT AND WORKING PLANS TO INSTALL AND PLACE INTO OPERATION THE COMPLETE FIRE PROTECTION SYSTEM (AUTOMATIC WET PIPE SPRINKLER SYSTEM) FOR THE ENTIRE BUILDING IN ACCORDANCE WITH THE ATTACHED PLANS AND AS SPECIFIED HEREIN.

C. All work shall meet requirements of the latest edition of the National Fire Protection Association (NFPA), Louisiana State Fire Marshal.

D. Prior to start of the design of the fire protection system, the contractor shall coordinate and complete the “Owner’s Information Certificate” form required by the State Fire Marshal. The form can be found at the State Fire Marshal’s website http://www.dps.louisiana.gov/sfm. The form shall identify special occupancies and commodity classifications and shall be given to the fire protection system designer before the start of design.

E. Sprinkler contractor shall visit site and familiarize himself with all existing conditions, examine plans and specifications to determine building conditions and coordinate with work being performed by other trades. Contractor shall make note that all calculations and plans required by the State Fire Marshal shall be provided by Sprinkler Contractor.

F. Each bidder shall be licensed to perform sprinkler work in the State of Louisiana and shall be recognized by Property Insurance Association of Louisiana as a reliable sprinkler contractor.

G. Sprinkler Contractor shall include in his price all offsets required in order to avoid conflict with ductwork, lights, grilles, air boxes, etc. All offsets shall be made above intersecting ducts or pipes in order to minimize trapping of water. Contractor shall coordinate installation of his piping with all other trades to assure that they can all fit in the space provided. In general, sprinkler piping shall be run at maximum height above finished floor or between joists in order to

minimize conflict with different trades. In areas where joists are exposed, lines shall be run at bottom of roof deck, between or through joists.

H. Contractor shall make note that sprinkler piping layout and sprinkler head locations are diagrammatic and all spaces shall have proper number of heads and proper pipe size in contractor's price.

I. Contractor shall also obtain latest flow data for local utility company and assure himself prior to bid that adequate pressures and flow are available for the system he intends to provide.

1.3 REQUEST FOR APPEAL

A. The Contractor shall be required to complete any and all “Appeals” to the State Fire Marshal’s Office required to clear review comments associated with shop drawings. The Contractor shall be required to complete the Appeal Forms and provide associated appeal costs for appeals associated with the project.
   1.
   2. Example of Appeals including but not limited to: Sprinkler head type below stands, Low Suction Control Valve required by DHH on Fire Pump applications, etc.

1.4 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

   1. Include plans, elevations, sections, and attachment details.
   2. Include diagrams for power, signal, and control wiring.
   3. Shop drawings shall be prepared by the contractor before commencing fire protection installation. The shop drawings shall be detailed as required by the State Fire Marshal’s Office and submitted through the Architect to the following for approval:
      a. State Fire Marshal.
      b. Local Fire Prevention Bureau.
   4. Provide review application fee as required by the State Fire Marshal. Contractor shall pay all applicable fees required for the project thru completion of project.
   5. All shop drawings plans and elevations shall be made at 1/8” scale and arranged same as contract drawings.
   6. Provide scaled site plan.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed by the qualified NICET certified designer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

B. Qualification Data: For qualified Installer and NICET designer.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Fire-hydrant flow test report.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

F. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.9 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified designer.
b. The contractor shall be a qualified fire protection contractor, licensed by the State of Louisiana and directly engaged in the installation of automatic fire sprinkler systems and other fire protection equipment.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.10 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified designer to design wet-pipe sprinkler systems.

1. Conduct a fire-hydrant flow test and indicate the following conditions:

a. Date:
b. Time:
c. Performed by:
d. Location of Residual Fire Hydrant R:
e. Location of Flow Fire Hydrant F:
f. Static Pressure at Residual Fire Hydrant R:
g. Measured Flow at Flow Fire Hydrant F:
h. Residual Pressure at Residual Fire Hydrant R:

2. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
b. Sprinkler Occupancy Hazard Classifications as per NFPA.

3. Minimum Density for Automatic-Sprinkler Piping Design as per NFPA:

4. Maximum Protection Area per Sprinkler: According to UL listing.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, SCHEDULE 40 Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Galvanized- and Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
   1. Pipe-Flange Gasket Materials: EPDM rubber gasket.
      a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
      b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
   2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
   1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

I. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Pressure Rating: 175-psig minimum.
   2. Galvanized Painted Uncoated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
   3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:
   1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

2.4 SPRINKLERS

A. Manufacturers shall be one of the following:
   1. Viking Corporation.
   2. Reliable Automatic Sprinkler Co.
   3. Grinnel.
   4. Tyco Fire & Building Products.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Residential Sprinklers: 175-psig maximum.

D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

E. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Residential Applications: UL 1626.
4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

F. Open Sprinklers with Heat-Responsive Element Removed: UL 199.

1. Nominal Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.

G. Sprinkler Finishes: Chrome plated.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

I. Sprinkler Guards:

1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.

2.5 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Standard: UL 464.
2. Type: Vibrating, metal alarm bell.
3. Size: 8-inch minimum diameter.
4. Finish: Red-enamel factory finish, suitable for outdoor use.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Water-Flow Indicators:

1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.

3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
4. Type: Paddle operated.
5. Pressure Rating: 250 psig.
6. Design Installation: Horizontal or vertical.

D. Pressure Switches:

1. Standard: UL 346.
2. Type: Electrically supervised water-flow switch with retard feature.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

2.6 PRESSURE GAGES

A. Standard: UL 393.

B. Dial Size: 3-1/2- to 4-1/2-inch diameter.

C. Pressure Gage Range: 0- to 250-psig minimum.

D. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Reuse existing water-service piping for service entrance to building.

B. Reuse the existing shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
   2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

L. Fill sprinkler system piping with water.

M. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing.

N. Install sleeves for piping penetrations of walls, ceilings, and floors.

O. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers with stainless steel braided fully welded flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid. Flexible hose shall not use gaskets and shall be true 1” hose sizes.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire department equipment. Provide letter to Architect with the approval of the thread type by the local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.11 PIPE HANGERS AND SUPPORTS

A. This Contractor shall furnish and install all foundations and supports required for his equipment unless indicated otherwise on the Drawings.

B. This Contractor shall furnish and install all escutcheons, inserts, thimbles, hangers, saddles, etc. required for the proper support and installation of his equipment and piping and he shall cooperate with other trades in locating and placing these items.

3.12 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Piping within the building 4" and smaller shall be Schedule 40 black steel pipe with threaded fittings. Piping larger than 4' shall be Schedule 40 black steel pipe with welded fittings. At Contractor's option, piping larger than 4" may be Schedule 10. At Contractor's option, roll grooved pipe with mechanical couplings may be used. Schedule 5 piping is not acceptable.

3.13 MECHANICAL GROOVED PIPING

A. At the contractor's option, roll grooved piping and fittings may be used for the Fire Protection and HVAC piping systems inside building in lieu of connections hereinbefore specified. Cut grooved piping is not acceptable.

B. Couplings shall be fabricated in two or more parts of malleable iron castings, in accordance Federal Specification QQ-I-666c, Grade II. Couplings gasket shall be molded synthetic rubber, per ASTM-D-75-61, Grade No. R615BZ. Coupling bolts shall be oval neck track head type with hexagonal heavy nuts, per ASTM A-183-60.

C. All pipe fittings shall be fabricated of malleable iron castings in accordance with Federal Specifications QQ-1-666c, Grade II. Where malleable fitting pattern is not available, fittings

fabricated from Schedule 40 steep pipe or standard wall seamless welded fittings with grooved ends may be used.

D. Before assembly of couplings, light coat pipe ends and outside of gaskets with cup grease or graphite paste to facilitate installation.

E. Pipe grooving shall be in accordance with the manufacturer's specifications contained in latest published literature.

3.14 VICTAULIC COUPLINGS

A. At the contractor's option, Victaulic couplings and fittings may be used for the Fire Protection and HVAC piping systems inside building in lieu of connections hereinbefore specified.

B. Couplings shall be manufactured in two or more parts of ASTM A-395 grade 65-45-15 and A-536 grade 65-45-12 ductile iron castings. Coupling gaskets shall be suited for the intended service as per manufacturer's guidelines and recommendations. Coupling bolts shall be zinc-plated carbon steel track head type with hexagonal heavy nuts, per ASTM A-183-60.

C. Rigid Couplings shall be Victaulic Style 07, FireLock™ Style 005, or equal with offsetting angle-pattern bolt pads, to provide rigidity and piping system support and hanging requirements in accordance with ANSI B31.1, B31.9, and NFPA 13.

D. Flexible Couplings shall be Victaulic Style 75, or Victaulic Style 77, or equal: Flexible Couplilngs shall used in locations where stress relief and vibration attenuation are required. Couplings shall be placed in close proximity to the vibration source.

E. Flange Adapters shall be Victaulic Style 741, or equal. Flange adapters shall be Class 150 flange adapters for grooved end pipe shall be manufactured in two or more parts of ASTM A-395 grade 65-45-15 and A-536 grade 65-45-12 ductile iron castings. Flange adapter gaskets shall be suited for the intended service as per manufacturer's guidelines and recommendations.

F. All pipe fittings used with pipe couplings shall be fabricated of ductile iron conforming to ASTM A-395 grade 65-45-15 and A-536 grade 65-45-12 or forged carbon steel conforming to ASTM A234 grade WPB. Where Victaulic ductile iron or forged carbon steel fitting patterns are not available, fittings fabricated from schedule 40 steel pipe conforming to ASTM A-53 with grooved ends may be used. Fittings used in fire protection service shall be UL listed and FM approved, equal to Victaulic FireLock™ fittings.

G. Pipe ends shall be clean and free from indentations, projections, and roll marks. Before assembly of couplings, lightly coat pipe ends and outside of gaskets with lubricant, cup grease or graphite paste to facilitate installation.

H. Pipe grooving shall be in accordance with the manufacturer's specifications contained in latest published literature.

I. All grooved couplings, fittings and flange adapters shall be the products of the same manufacturer. Grooving tools shall be of the same manufacturer as the grooved end components.

3.15 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Pendent, dry sprinklers.
5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Upright and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

SECTION 21 13 16

DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Specialty valves.
3. Sprinkler specialty pipe fittings.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

B. Furnish all materials, labor, tools, equipment and working plans to install and place into operation the complete Fire Protection System (Automatic DRY Pipe Sprinkler System) for the entire building in accordance with the attached plans and as specified herein.

C. All work shall meet requirements of the latest edition of the National Fire Protection Association (NFPA), Louisiana State Fire Marshal.

D. Prior to start of the design of the fire protection system, the contractor shall coordinate and complete the “Owner’s Information Certificate” form required by the State Fire Marshal. The form can be found at the State Fire Marshal’s website http://www.dps.louisiana.gov/sfm. The form shall identify special occupancies and commodity classifications and shall be given to the fire protection system designer before the start of design.

E. Sprinkler contractor shall visit site and familiarize himself with all existing conditions, examine plans and specifications to determine building conditions and coordinate with work being performed by other trades. Contractor shall make note that all calculations and plans required by the State Fire Marshal shall be provided by Sprinkler Contractor.

F. Each bidder shall be licensed to perform sprinkler work in the State of Louisiana and shall be recognized by Property Insurance Association of Louisiana as a reliable sprinkler contractor.

G. Sprinkler Contractor shall include in his price all offsets required in order to avoid conflict with ductwork, lights, grilles, air boxes, etc. All offsets shall be made above intersecting ducts or pipes in order to minimize trapping of water. Contractor shall coordinate installation of his piping with all other trades to assure that they can all fit in the space provided. In general, sprinkler piping shall be run at maximum height above finished floor or between joists in order to

minimize conflict with different trades. In areas where joists are exposed, lines shall be run at bottom of roof deck, between or through joists.

H. Contractor shall make note that sprinkler piping layout and sprinkler head locations are diagrammatic and all spaces shall have proper number of heads and proper pipe size in contractor's price.

I. Contractor shall also obtain latest flow data for local utility company and assure himself prior to bid that adequate pressures and flow are available for the system he intends to provide.

1.3 REQUEST FOR APPEAL

A. The ontractor shall be required to complete any and all “Appeals” to the State Fire Marshal’s Office required to clear review comments associated with shop drawings. The Contractor shall be required to complete the Appeal Forms and provide associated appeal costs for appeals associated with the project.

B. Example of Appeals including but not limited to: Sprinkler head type below stands, Low Suction Control Valve required by DHH on Fire Pump applications, etc.

1.4 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For dry-pipe sprinkler systems.
1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.
3. Shop drawings shall be prepared by the contractor before commencing fire protection installation. The shop drawings shall be detailed as required by the State Fire Marshal’s Office and submitted through the Architect to the following for approval:
   a. State Fire Marshal.
   b. Local Fire Prevention Bureau.
4. Provide review application fee as required by the State Fire Marshal. Contractor shall pay all applicable fees required for the project thru completion of project.
5. All shop drawings plans and elevations shall be made at 1/8” scale and arranged same as contract drawings.
6. Provide scaled site plan.

C. Delegated-Design Submittal: For dry-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
2. Compressed air piping.
3. HVAC hydronic piping.
4. Medical Gas and Vacuum Piping.
5. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.

B. Qualification Data: For qualified Installer and NICET designer.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Fire-hydrant flow test report.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

F. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.9 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

1.10 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Architect's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.

2.2 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

D. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

2. Maximum Protection Area per Sprinkler: According to UL listing.

2.3 STEEL PIPE AND FITTINGS

A. Standard-Weight, SCHEDULE 40 Galvanized-Steel Pipe: ASTM A 53/A 53M,, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized-Steel Couplings: ASTM A 865/A 865M, threaded.

D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME B16.1, Class 125.

G. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.

H. Grooved-Joint, Steel-Pipe Appurtenances:
1. Pressure Rating: 175-psig minimum.
2. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.4 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Dry-Pipe Valves:
1. Standard: UL 260.
2. Design: Differential-pressure type.
3. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
4. Air-Pressure Maintenance Device:

5. Standard: UL 260.
6. Type: Automatic device to maintain minimum air pressure in piping.
7. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.
8. Air Compressor:
   a. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
   b. Motor Horsepower: Fractional.
   c. Power: 120-V ac, 60 Hz, single phase.

G. Automatic (Ball Drip) Drain Valves:
1. Standard: UL 1726.
2. Pressure Rating: 175-psig minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4.
5. End Connections: Threaded.

2.5 SPRINKLER PIPING SPECIALTIES

A. General Requirements for Dry-Pipe System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings:
   1. Standard: UL 213.
   2. Pressure Rating: 175-psig minimum.
   3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
   4. Type: Mechanical-tee and -cross fittings.
   5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
   6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
   7. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:
   1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
   2. Pressure Rating: 175-psig minimum.
   3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
   4. Size: Same as connected piping.
   5. Inlet and Outlet: Threaded.

D. Branch Line Testers:
   1. Standard: UL 199.
   2. Pressure Rating: 175-psig minimum.
   3. Body Material: Brass.
   4. Size: Same as connected piping.
   5. Inlet: Threaded.
   6. Drain Outlet: Threaded and capped.
   7. Branch Outlet: Threaded, for sprinkler.

E. Sprinkler Inspector's Test Fittings:
   1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
   2. Pressure Rating: 175-psig minimum.
   3. Body Material: Cast- or ductile-iron housing with sight glass.
   4. Size: Same as connected piping.
   5. Inlet and Outlet: Threaded.

F. Adjustable Drop Nipples:
   1. Standard: UL 1474.
   2. Pressure Rating: 250-psig minimum.
   3. Body Material: Steel pipe with EPDM O-ring seals.
   4. Size: Same as connected piping.
   5. Length: Adjustable.
   6. Inlet and Outlet: Threaded.

G. Flexible Sprinkler Hose Fittings:
   1. Standard: UL 1474.
   2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
   3. Pressure Rating: 175-psig minimum.
   4. Size: Same as connected piping, for sprinkler.

2.6 SPRINKLERS

A. Manufacturers shall be one of the following:
   1. Viking Corporation.
   2. Reliable Automatic Sprinkler Co.
   3. Grinnel.
   4. Tyco Fire & Building Products.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Residential Sprinklers: 175-psig maximum.

D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

E. Pressure Rating for High-Pressure Automatic Sprinklers: 250-psig minimum.

F. Automatic Sprinklers with Heat-Responsive Element:

   1. Nonresidential Applications: UL 199.
   2. Residential Applications: UL 1626.
   3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

G. Sprinkler Finishes: Chrome plated.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

   1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
   2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

I. Sprinkler Guards:
   1. Standard: UL 199.
   2. Type: Wire cage with fastening device for attaching to sprinkler.

2.7 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:
   1. Standard: UL 753.
   2. Type: Mechanically operated, with Pelton wheel.
   3. Alarm Gong: Cast aluminum with red-enamel factory finish.
   4. Size: 10-inch diameter.
   5. Components: Shaft length, bearings, and sleeve to suit wall construction.
   6. Inlet: NPS 3/4.
   7. Outlet: NPS 1 drain connection.

C. Pressure Switches:
   1. Standard: UL 346.
   2. Type: Electrically supervised water-flow switch with retard feature.
   3. Components: Single-pole, double-throw switch with normally closed contacts.

4. Design Operation: Rising pressure signals water flow.

D. Valve Supervisory Switches:
1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

2.8 MANUAL CONTROL STATIONS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.

B. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.9 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.

1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

B. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

C. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

D. Panels Components:

1. Power supply.
2. Battery charger.
3. Standby batteries.
4. Field-wiring terminal strip.
5. Electrically supervised solenoid valves and polarized fire-alarm bell.
6. Lamp test facility.
7. Single-pole, double-throw auxiliary alarm contacts.
8. Rectifier.

2.10 PRESSURE GAGES

A. Standard: UL 393.

B. Dial Size: 3-1/2- to 4-1/2-inch diameter.

C. Pressure Gage Range: .

D. Label: Include "WATER" or "AIR/WATER" label on dial face.

E. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

B. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."

B. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or to outside building.

K. Connect compressed-air supply to dry-pipe sprinkler piping.

L. Connect air compressor to the following piping and wiring:

1. Pressure gages and controls.
2. Electrical power system.
3. Fire-alarm devices, including low-pressure alarm.

M. Install alarm devices in piping systems.

N. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

O. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

P. Drain dry-pipe sprinkler piping.

Q. Pressurize and check dry-pipe sprinkler system piping and air compressors.

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.5 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

J. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

K. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.

M. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install dry-pipe valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

    a. Install air compressor and compressed-air-supply piping.
    b. Install air-pressure maintenance device with shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
    c. Install compressed-air-supply piping from building's compressed-air piping system.

3.7 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center (Center-of-tile) acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.12 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, dry-pipe sprinkler system, NPS 2 and smaller, shall be the following:

1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

D. Standard-pressure, dry-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be the following:

1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

E. Standard-pressure, dry-pipe sprinkler system, NPS 5 and NPS 6, shall be the following:

1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

3.13 MECHANICAL GROOVED PIPING

A. At the contractor's option, roll grooved piping and fittings may be used for the Fire Protection and HVAC piping systems inside building in lieu of connections hereinbefore specified. Cut grooved piping is not acceptable.

B. Couplings shall be fabricated in two or more parts of malleable iron castings, in accordance Federal Specification QQ-I-666c, Grade II. Couplings gasket shall be molded synthetic rubber, per ASTM-D-75-61, Grade No. R615BZ. Coupling bolts shall be oval neck track head type with hexagonal heavy nuts, per ASTM A-183-60.

C. All pipe fittings shall be fabricated of malleable iron castings in accordance with Federal Specifications QQ-1-666c, Grade II. Where malleable fitting pattern is not available, fittings fabricated from Schedule 40 steep pipe or standard wall seamless welded fittings with grooved ends may be used.

D. Before assembly of couplings, light coat pipe ends and outside of gaskets with cup grease or graphite paste to facilitate installation.

E. Pipe grooving shall be in accordance with the manufacturer's specifications contained in latest published literature.

3.14 VICTAULIC COUPLINGS

A. At the contractor's option, Victaulic couplings and fittings may be used for the Fire Protection and HVAC piping systems inside building in lieu of connections hereinbefore specified.

B. Couplings shall be manufactured in two or more parts of ASTM A-395 grade 65-45-15 and A-536 grade 65-45-12 ductile iron castings. Coupling gaskets shall be suited for the intended service as per manufacturer's guidelines and recommendations. Coupling bolts shall be zinc-plated carbon steel track head type with hexagonal heavy nuts, per ASTM A-183-60.

C. Rigid Couplings shall be Victaulic Style 07, FireLock™ Style 005, or equal with offsetting angle-pattern bolt pads, to provide rigidity and piping system support and hanging requirements in accordance with ANSI B31.1, B31.9, and NFPA 13.

D. Flexible Couplings shall be Victaulic Style 75, or Victaulic Style 77, or equal: Flexible Couplilngs shall used in locations where stress relief and vibration attenuation are required. Couplings shall be placed in close proximity to the vibration source.

E. Flange Adapters shall be Victaulic Style 741, or equal. Flange adapters shall be Class 150 flange adapters for grooved end pipe shall be manufactured in two or more parts of ASTM A-395 grade 65-45-15 and A-536 grade 65-45-12 ductile iron castings. Flange adapter gaskets shall be suited for the intended service as per manufacturer's guidelines and recommendations.

F. All pipe fittings used with pipe couplings shall be fabricated of ductile iron conforming to ASTM A-395 grade 65-45-15 and A-536 grade 65-45-12 or forged carbon steel conforming to ASTM A234 grade WPB. Where Victaulic ductile iron or forged carbon steel fitting patterns are not available, fittings fabricated from schedule 40 steel pipe conforming to ASTM A-53 with grooved ends may be used. Fittings used in fire protection service shall be UL listed and FM approved, equal to Victaulic FireLock™ fittings.

G. Pipe ends shall be clean and free from indentations, projections, and roll marks. Before assembly of couplings, lightly coat pipe ends and outside of gaskets with lubricant, cup grease or graphite paste to facilitate installation.

H. Pipe grooving shall be in accordance with the manufacturer's specifications contained in latest published literature.

I. All grooved couplings, fittings and flange adapters shall be the products of the same manufacturer. Grooving tools shall be of the same manufacturer as the grooved end components.

3.15 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Dry concealed sprinklers.
3. Wall Mounting: Dry sidewall sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

SECTION 22 00 00

PLUMBING GENERAL PROVISIONS

PART 1 GENERAL

1.1 SUMMARY

A. The General Conditions of the Architectural Specifications, along with the supplementary conditions, special conditions, information to bidders, and any other pertinent information and documents shall apply the same as if repeated herein.

1.2 SCOPE OF WORK

A. Furnish all labor and material necessary to provide and install the complete mechanical portion of this Contract, including plumbing systems as called for herein and on accompanying drawings. Parts of the mechanical division may be bid separately or in combination, at the Contractor's option; however, it shall be the responsibility of the General Contractor to assure himself that all items covered in the this Division have been included if he chooses to accept separate bids.

B. This Contractor shall refer to the Architectural and Structural drawings and install equipment, piping, etc. to meet building and space requirements. No equipment shall be bid on or submitted for approval if it will not fit in the space provided.

C. It is the intention of these Specifications that all mechanical systems shall be furnished complete with all necessary valves, controls, insulation, piping, devices, equipment, etc. necessary to provide a satisfactory installation in working order.

D. Contractor shall visit the site and acquaint himself thoroughly with all existing facilities and conditions which would affect his portion of the work. Failure to do so shall not relieve the Contractor from the responsibility of installing his work to meet the conditions.

This Contractor shall protect the entire system and all parts thereof from injury throughout the project and up to acceptance of the work. Failure to do so shall be sufficient cause for the Architect to reject any piece of equipment.

1.3 DEMOLITION

A. The contractor shall visit the site prior to bid to determine the extent of work required to complete the project.

B. Contractor shall coordinate demolition with owner. The Owner shall have “First Right of Refusal” regarding salvage of all equipment and materials to be removed. Locate equipment as directed by owner. All equipment and materials not salvaged by the owner shall be removed from the site and discarded at the contractor’s expense.

C. Contractor shall coordinate all work with general contractor and phase work as required by project.

D. All equipment piping, etc. required to be removed to accommodate the modifications shall be removed.

E. Contractor shall maintain services to existing facilities which shall remain during and after construction is complete.

F. Contractor shall coordinate any shutdown of services with the owner. It is intended that the building will remain occupied during construction. Contractor shall schedule shut down of services with the owner in order to prevent disruption of building occupancy.

G. Contractor shall be responsible for draining down of existing systems to complete demolition. All work shall be scheduled with the owner. Contractor shall also be responsible for refilling system and removing all air in order to return the systems to proper operating conditions.

H. All shut down of services shall be done at night or during a time period approved by the owner. The systems shall be required to be back up and running each morning unless otherwise approved by the owner.

1.4 GROUNDS AND CHASES

A. This Contractor shall see that all required chases, grounds, holes and accessories necessary for the installation of his work are properly built in as the work progresses; otherwise, he shall bear the cost of providing them.

1.5 CUTTING AND PATCHING

A. Initial cutting and patching shall be the responsibility of the General Contractor, with the Mechanical Contractor being responsible for laying out and marking any and all holes required for the reception of his work. No structural beams or joists shall be cut or thimbled without first receiving the approval of the Architect. After initial surfacing has been done, any further cutting, patching and painting shall be done at this Contractor's expense.

1.6 FILL AND CHARGES FOR EQUIPMENT

A. Fill and charge with materials or chemicals all those devices or equipment as required to comply with the manufacturer's guarantee or as required for proper operation of the equipment.

1.7 MACHINERY GUARDS

A. This Contractor shall provide v-belt guards for each v-belt drive or other hazardous drive. The guard shall enclose the drive entirely and shall have a hole for taking a tachometer reading.

B. Provide protective guard for belts, pulleys, gears, couplings, projecting set screws, keys and other rotating parts which are located such that a person might come in close proximity. Construct protective guard around angle iron frame, securely bolted to apparatus; comply with safety requirements. Install guard to completely enclose drives and pulleys and not interfere with lubrication of equipment. Provide 2 inch minimum diameter opening in fan belt guards housing for tachometer.

1.8 REPAIRING ROADWAYS AND WALKS

A. Where this Contractor cuts or breaks roadways or walks, in order to lay piping, he shall repair or replace these sections to meet the Architect's approval.

1.9 EXCAVATION AND BACKFILL

A. Contractor shall perform all excavating necessary to lay the specified services. Perform excavation of every description and of whatever substance encountered to depths indicated or specified. Pile materials suitable for backfilling a sufficient distance from banks of trenches to prevent slides or cave-ins. Comply with OSHA requirements for excavation, trenching and shoring. Waste excavation materials, rubbish, etc. shall be carted away from the premises, as indicated. Remove water from trenches by pumping or other approved method, discharge at a safe distance from the excavation.

B. Provide trenches of necessary width for proper laying of pipe and comply with latest publication of OSHA 2226 Excavating and Trenching Operations. Coordinate trench excavation with pipe installation to avoid open trenches for prolonged periods. Accurately grade bottoms of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil or the required thickness of bedding material at every point along its entire length.

C. Provide minimum 12 inches between outer surfaces and embankment or shoring, which may be used, when excavating for manholes and similar structures. Remove unstable soil that is incapable of supporting the structure in the bottom of the excavation to the depth necessary to obtain design bearing.

D. Material to be excavated is “unclassified”. No adjustment in the contract price will be made on account of the presence or absence of rock, shale, masonry, or other materials.

E. Protect existing utility lines that are indicated or the locations of which are made known prior to excavating and trenching and that are to be retained. Protect utility lines encountered during excavating and trenching operations, from damage during excavating, trenching and backfilling; if damaged, repair lines as directed by utilities, owner and A/E. Issue notices when utility lines that are to be removed are encountered within the area of operations in ample time for the necessary measures to be taken to prevent interruption of the service.

F. Provide trenches for utilities of a depth that will provide the following minimum depths of cover from existing grade or from indicated finished grades, or depths of cover in accordance with the manufacturer’s recommendations, whichever is lower:

1. 1-Foot Minimum Cover: Sanitary sewer.
2. 3-Feet Minimum Cover: Domestic water, fire line.

G. Underground domestic water piping and fire line piping shall have a 6" bed of sand below the piping and backfilled with sand to 6" above the top of piping. Select fill may be used above the sand layer.

H. Backfill trenches after piping, fittings and joints have been tested and approved. Backfill trenches with sand to provide 6 inches of sand below piping and 12 inches of sand cover above piping.

I. Backfill remainder of trenches with satisfactory material consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones not over 1-1/2 inches

in size. Deposit backfill material in 9 inch maximum layers, loose depth as indicated or as specified. Take care not to damage utility lines.

J. Deposit the remainder of backfill materials in the trench in 1 foot maximum layers and compact by mechanical means. Refer to architectural for minimum density for compaction (Minimum 85 percent of maximum soil density as determined by ASTM D 698). Re-open trenches and excavation pits improperly backfilled or where settlement occurs to the depth required to obtain the specified compaction, the refill and compact with the surface restored to the required grade and compaction.

K. Backfill utility line trench with backfill material, in 6 inch layers, where trenches cross streets, driveways, building slabs, or other pavement. Moisten each layer and compact to 95 percent of the maximum soil density as determined by ASTM D 698. Accomplish backfilling in such a manner as to permit the rolling and compaction of the filled trench with the adjoining material to provide the required bearing value so that paving of the area can proceed immediately after backfilling is complete.

1.10 NOISE AND VIBRATION

A. Provide the plumbing system and its associated components, items, piping, and equipment free of objectionable vibration or noise. Statically and dynamically balance rotating equipment and mount or fasten so that no vibration is transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional compensation.

1.11 PAINTING

A. All painting shall be by the General Contractor's Painting Sub-Contractor. All pipe, pipe covering, equipment, supports, hangers, etc. exposed in the building or equipment room shall be painted. This Contractor shall prepare the surface of the material to receive the first coat of paint.

B. All subsequent coatings shall be prepared by the Painting Sub-Contractor. Requirements covering paints, workmanship and preparation of surfaces as stated in the Architectural Specifications shall govern. Colors shall be approved by the Architect. All piping shall be color-coded.

C. All piping shall be color coded per the following:

1.	Natural Gas Piping (Exposed in Mechanical Room)	Yellow
2.	Natural Gas Piping (Outdoor, Roof, Exterior of Building)	Yellow
3.	Natural Gas Piping (Exposed in Building)	Black
4.	Sanitary Sewer Waste & Vent (Exposed in Building)	Black

a. Thermoplastic pipe and fittings shall be painted using latex(water base) paint .
b. Pipe should be cleaning to remove moisture, dirt and oil; then wiped with a clean, dry cloth.
c. Do not use petroleum based paints.

1.12 CLEANING AND ADJUSTING

A. Upon completion of his work, the Contractor shall clean and adjust all equipment, controls, valves, etc.; clean all piping, ductwork, etc.; and leave the entire installation in good working order.

1.13 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Provide the Owner with three (3) copies of printed instructions indicating various pieces of equipment by name and model number, complete with parts lists, maintenance and repair instructions and test and balance report.

B. COPIES OF SHOP DRAWINGS WILL NOT BE ACCEPTABLE AS OPERATION AND MAINTENANCE INSTRUCTIONS BUT MUST BE INCLUDED IN SUBMITTAL PACKAGE.

C. This information shall be bound in plastic hardbound notebooks with the job name permanently embossed on the cover. Rigid board dividers with labeled tabs shall be provided for different pieces of equipment. Submit manuals to the Architect for approval.

D. In addition to the operation and maintenance brochure, the Contractor shall provide a separate brochure which shall include registered warranty certificates on all equipment, especially any pieces of equipment which carry warranties exceeding one (1) year.

E. The operation and maintenance brochure shall be furnished with a detailed list of all equipment furnished to the project, including the serial number and all pertinent nameplate data such as voltage, amperage draw, recommended fuse size, rpm, etc. The Contractor shall include this data on each piece of equipment furnished under this contract.

1.14 GUARANTEE

A. The Contractor shall guarantee all materials, equipment and workmanship for a period of one (1) year from the date of final acceptance of the project. This guarantee shall include furnishing of all labor and material necessary to make any repairs, adjustments or replacement of any equipment, parts, etc. necessary to restore the project to first class condition. This guarantee shall exclude only the changing or cleaning of filters. Warranties exceeding one (1) year are hereinafter specified with individual pieces of equipment.

1.15 LOCAL CONDITIONS

A. The location and elevation of all utility services is based on available surveys and utility maps and are reasonably accurate; however, these shall serve as a general guide only, and the Contractor shall visit the site and verify the location and elevation of all services to his satisfaction in order to determine the amount of work required for the execution of the Contract.

B. The Contractor shall contact the various utility companies, determine the extent of their requirements and he shall include in his bid all lawful fees and payments required by these companies for complete connection and services to the building, including meters, connection charges, street patching, extensions from meters to main, etc.

C. In case major changes are required, this fact, together with the reasons therefor, shall be submitted to the Architect, in writing, not less than seven (7) days before the date of bidding. Failure to comply with this requirement will make the Contractor liable for any changes, additions and expenses necessary for the successful completion of the project.

1.16 PERMITS, INSPECTIONS AND TESTS

A. All permits, fees, etc. for the installation, inspections, plan review, service connections locations, and/or construction of the work which are required by any authority and/or agencies having jurisdiction, shall be obtained and paid for by the Contractor. This shall be verified during the bidding process.

B. The Contractor shall make all tests required by the Architect, Engineer or other governing authorities at no additional cost to the Owner.

C. The Contractor shall notify the Architect and local governing authorities before any tests are made, and the tests are not to be drawn off a line covered or insulated until examined and approved by the authorities. In event defects are found, these shall be corrected and the work shall be retested.

D. Prior to requesting final inspection by the Architect, the Contractor shall have a complete coordination and adjustment meeting of all of his sub-contractors directly responsible for the operation of any portion of the system. At the time of this meeting, each and every sequence of operation shall be checked to assure proper operation. Notify the Architect in writing ten (10) days prior to this meeting, instructing him of the time, date and whom you are requesting to be present.

E. This project shall not be accepted until the above provisions are met to the satisfaction of the Architect.

1.17 CODES AND STANDARDS

A. The entire mechanical work shall comply with the rules and regulations of the City, Parish, County and the State in which this project is being constructed, including the State Fire Marshal and the State Department of Health. Modifications required by these authorities shall be made without additional charge to the Owners. The Contractor shall report these modifications to the Architect and secure his approval before work is started.

B. In addition to the codes heretofore mentioned, mechanical work and equipment shall conform to the applicable portions of the following specifications, codes and/or regulations:

1. American Society of Heating, Refrigeration and
2. Air Conditioning Engineers (ASHRAE)
3. National Electrical Code (NEC)
4. National Fire Protection Association (NFPA)
5. American Society of Mechanical Engineers (ASME)
6. American Gas Association (AGA)
7. International Building Code (IBC)
8. International Mechanical Code (IMC)
9. International Plumbing Code (IPC)
10. International Fuel Gas Code (IFGC)
11. Underwriters Laboratories (UL)
12. Life Safety Code (NFPA 101)
13. State Sanitary Code
14. Louisiana State Uniform Construction Code Council (LSUCCC)
15. Facility Guidelines Institute “Guidelines for Design and Construction of Hospitals and Outpatient Facilities” (2014 Edition)

C. Materials, equipment and accessories installed under this Contract shall conform to the rules, codes, etc. as recommended by National Associations governing the manufacturer, rating and testing of such materials, equipment and accessories. Materials shall be new

and of the best quality and first class in every respect. Whenever directed by the Architect, the Contractor shall submit a sample for approval before proceeding.

D. Where laws or local regulations provide that certain accessories such as gauges, thermometers, relief valves and parts be installed on equipment, it shall be understood that such equipment be furnished complete with the necessary accessories, whether or not called for in these Specifications.

E. Unfired pressure vessels shall be built in accordance with the A.S.M.E. Code and so stamped. Furnish shop certificates for each vessel.

1.18 REVIEW OF MATERIALS

A. Whenever manufacturers or trade names are mentioned in these Plans or Specifications, the words "or approved equivalent" shall be assumed to follow whether or not so stated. Manufacturers or trade names are used to establish a standard of quality only, and should not be construed to infer a preference. Equivalent products which meet the Architect's approval will be accepted; however, these products must be submitted to the Architect a minimum of seven (7) days prior to the Bid Date.

B. Submission shall include the manufacturer's name, model number, rating table and construction features.

C. Upon receipt and checking of this submittal, the Architect will issue an addendum listing items which are approved as equivalent to those specified. THE CONTRACTOR SHALL BASE HIS BID SOLELY ON THOSE ITEMS SPECIFIED OR INCLUDED IN THE "PRIOR APPROVAL ADDENDUM", AS NO OTHER ITEM WILL BE ACCEPTABLE.

D. Prior approval of a particular piece of equipment does not mean automatic final acceptance and will not relieve the Contractor of the responsibility of assuring himself that this equipment is in complete accord with the Plans and Specifications and that it will fit into the space provided. Shop drawings must be submitted on all items of equipment for approval as hereinafter specified.

E. Before proceeding with work and/or within thirty (30) days after the award of the General Contract for this work, the Mechanical Contractor shall furnish to the Architect complete shop and working drawings of such apparatus, equipment, controls, insulation, etc. to be provided in this project. These drawings shall give dimensions, weights, mounting data, performance curves and other pertinent information.

F. The Architect's approval of shop drawings shall not relieve the Contractor from the responsibility of incorrectly figured dimensions or any other errors which may be contained in these drawings. Any omission from the shop drawings or specifications, even though approved by the Architect, shall not relieve the Contractor from furnishing and erecting same.

G. Six (6) sets of shop drawings shall be submitted to the Architect for approval. These submittals shall be supplied as part of this Contractor's contract. Any drawings not approved shall be resubmitted until they are approved.

H. This information shall be bound in plastic hardbound notebooks with the job name permanently embossed on the cover. Rigid board dividers with labeled tabs shall be provided for different pieces of materials and equipment. Submit shop drawings to the Architect for approval. Faxed copies submissions will not be accepted.

1.19 MINOR DEVIATIONS

A. Plans and detail sketches are submitted to limit, explain and define conditions, specified requirements, pipe sizes and manner of erecting work. Structural or other conditions may require certain modifications from the manner of installation shown, and such deviations are permissible and shall be made as required. However, specified sizes and requirements necessary for satisfactory operation shall remain unchanged. It may be necessary to shift ducts or pipes, or to change the shape of ducts, and these changes shall be made as required. All such changes shall be referred to the Architect and Engineer for approval before proceeding. Extra charges shall not be allowed for these changes. The contractor shall obtain a full set of plans and specifications for the coordination of his work prior to bidding this project. Items which are unclear to the bidding contractor shall be brought to the Architect and Engineers attention prior to bidding the project. An interpretation shall be clarified by the Architect and/or the Engineer prior to bidding.

B. The Contractor shall realize that the drawings could delve into every step, sequence or operation necessary for the completion of the project, without drawing on the Contractor's experience or ingenuity. However, only typical details are shown on the Plans. In cases where the Contractor is not certain about the method of installation of his work, he shall ask for details. Lack of details will not be an excuse for improper installation.

C. In general, the drawings are diagrammatic and the Contractor shall install his work in a manner so that interferences between the various trades are avoided. In cases where interferences do occur, the Architect is to state which item was first installed.

1.20 AS-BUILT RECORD DRAWINGS

A. The Contractor shall obtain at his cost, two sets of blue line prints of the original bid documents by the Architect. One set shall be kept on the site with all information as referenced below, and shall update same as the work progresses. The other set will be utilized to record all field changes to a permanent record copy for the Owner.

B. If the Contractor elects to vary from the Contract Documents and secures prior approval from the Architect for any phase of the work, he shall record in a neat and readable manner, ALL such variances on the blackline print in red. The original blackline prints shall be returned to the Architect for documentation.

C. All deviations from sizes, locations, and from all other features of the installations shown in the Contract Documents shall be recorded.

D. In addition, it shall be possible using these drawings to correctly and easily locate, identify and establish sizes of all piping, directions and the like, as well as other features of the work which will be concealed underground and/or in the finished building.

E. Locations of underground work shall be established by dimensions to columns, lines or walls, locating all turns, etc., and by properly referenced centerline or invert elevations and rates of fall.

F. For work concealed in the building, sufficient information shall be given so it can be located with reasonable accuracy and ease. In some cases this may be by dimension. In others, it may be sufficient to illustrate the work on the drawings in relation to the spaces in the building near which it was actually installed. The Architect's/Engineer's decision in this matter will be final.

G. The following requirements apply to all "As-Built" drawings:

1. They shall be maintained at the Contractor's expense.
2. All such drawings shall be done carefully and neatly, and in a form approved by the Architect/Engineer.
3. Additional drawings shall be provided as necessary for clarifications.
4. These drawings shall be kept up-to-date during the entire course of the work and shall be available upon request for examination by the Architect/Engineer; and when necessary, to establish clearances for other parts of the work.
5. "As-built" drawings shall be returned to the Architect upon completion of the work and are subject to approval of the Architect/Engineer.

1.21 REQUIRED SHOP DRAWING SUBMITTALS

A. Provide the following shop drawing submittals:

1. Pipe insulation.
2. All Valves.
3. Plumbing fixtures and trim.
4. Pipe and pipe fittings.
5. PVC jacket color samples.
6. Mixing Valves.
7. Pumps.
8. Backflow preventors.

PART 2 PRODUCTS

2.1 PLUMBING PRODUCTS

A. Refer to individual Division 22 sections for plumbing products, pipe, tube and fitting materials and joining methods.

PART 3 EXECUTION

3.1 MANUFACTURER'S DIRECTION

A. The contractor shall install and operate equipment and material in accordance with the manufacturer's installation and operating instructions. The manufacturer's instructions of installation and operation shall become part of the Contract Documents and shall supplement the Drawings and Specifications.

B. Store equipment in a clean, dry place protected from other construction. While stored, maintain factory wrapping or tightly cover and protect equipment against dirt, water, construction debris, chemical, physical or weather damage, traffic and theft.

3.2 EQUIPMENT LABELS

A. Provide equipment labels for water heaters and mixing valves. Labels shall have permanent laminated construction secured to equipment.

3.3 PIPE LABELS

A. Provide pipe markers and directional arrows on all piping in mechanical equipment rooms, or which is exposed in building, and on both sides of all valves located above ceiling. Markers shall be as manufactured by W.H. Bradley Co., Marking Services Inc. or the equivalent. All letters shall be color-coded and sized as recommended by OSHA. Samples of the type of letters to be used shall be submitted with shop drawings. Piping shall be color-coded.

B. Pipe markers with arrows shall indicate lines content and shall be located 20 feet on center and at each change of direction of line. Identification bands shall be color coded to match pipe markers and shall be provided 10 feet on center. Pipe identification markers shall be taped at each end and shall be taped around the entire circumference of pipe.

C. The following Piping shall be identified:

1. Domestic Cold Water
2. Domestic Hot Water
3. Domestic Hot Water Return
4. Natural Gas
5. Sanitary Vent
6. Condensate Drain
7. Filtered Water
8. Compressed Air

3.4 VALVE TAGS

A. Secure metal tags to all valves. Labeling on all valve tags shall include type of system the valve controls and the area of building, zone, or equipment number affected by valve operation. Tag shall be 2"minimum diameter brass, engraved with code number, service and size. A framed list of the valves, giving manufacturer's name, model number, type and location shall be mounted in the main equipment room.

3.5 ACCESS DOORS:

A. Provide access doors in walls, floors and ceilings to permit access to equipment and piping requiring service or adjustment.

1. Valves.
2. Plumbing drainage cleanouts.
3. Other Plumbing equipment indicated in schedules or specifications which are
4. Drywall Construction:

    a. Provide with concealed spring hinges and flush screwdriver operated cam locks in sufficient number of the size of the panel.
    b. Provide prime paintable surface (not galvanized).
    c. Product: Milcor “Style M” (Karp DSC-214M).

5. Visible Masonry and Ceramic Tile:

    a. Milcor “Style M” (Karp DSC-214M).

6. Cement Plaster:

    a. Milcor “Style K” (KarpDSC-214 PL).
7. Acoustical Plaster:

a. Reinforced panel as required to prevent sagging. Provide continuous steel piano type hinge for the length of the panel, and sufficient number for the size of the panel. Provide factory prime paint surface (not galvanized).
b. Product: Milcor “Style AP” (Karp 214 PL).

8. Acoustical Tile:

a. Milcor “Style AT” (Larsen L-CPA).

B. Provide continuous concealed hinges and cam locks.

C. Provide UL listed 1-1/2 hour label “B” access doors with automatic self-closing latching mechanism where required.

D. Provide removable ceiling access tile section immediately adjacent to each mechanical or electrical device located in the ceiling plenum above removable tile ceiling.

E. Coordinate approval of type, color and location of access doors & frames with Architect.

3.6 CLEANING AND SERVICE

A. Upon Completion of this work, the contractor shall clean and adjust equipment, controls, valves, etc.;

B. Clean piping, fixtures, cleanout covers, floor drain covers, etc. and leave the entire installation in good working order.

C. Adjust flush valves and faucets to allow for proper operation.

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes the furnishing and installation of general duty valves for plumbing:

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G and NSF 372 (lead free).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Hand lever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 MANUFACTURERS

A. Valves shall be manufactured by one of the following:

1. Kitz.
2. Red & White.
3. Nibco.
4. Kennedy.
5. Crane.
6. Milwaukee.
7. Keystone.
8. Stockham.
9. Grinnell.
10. Mueller.
11. Jamesbury.
12. DeZurik.
13. Hammond.
14. Apollo.

2.3 BRONZE BALL VALVES

A. Two-Piece, Bronze Ball Valves with Full Port and Brass Trim:

1. Kitz 59/69, Apollo 77C, NIBCO Design S-580-70, Milwaukee BA-150-S, Red & White 5049F or equal, threaded ends of heating hot water and low pressure steam of Kitz 58/68, Apollo 77CLF, NIBCO Design T-580-70, Milwaukee BA-100-S, Red & White 5044F or equal. For insulated piping systems, provide ball valves with extended stem, insulated handle with protective thermal barrier sleeve to prevent condensate moisture drip and pipe insulation deterioration.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. SSP Rating: 150 psi.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded and soldered.
g. Seats: PTFE.
h. Stem: Brass. Blow-out proof.
i. Ball: Chrome-plated brass.
j. Port: Full.
k. Vinyl covered steel handle.
l. Lead Free.
m. Conforms to ASTM B-62.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown. Unions are not required on flanged devices.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags.

F. All valves, unions, etc. where pipe is chrome plated shall have similar finish. All exposed supplies to plumbing fixtures shall be chrome plated.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. All gas cocks, valves, etc. on gas lines shall have local utility company and AGA approval.

C. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Solder ends, except provide threaded ends for heating hot water.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends or grooved ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Grooved end or Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Grooved end or Flanged ends.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 3 and Smaller (above grade):

1. Two-piece, bronze ball valves with full port and brass trim.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.

3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. B-line, an Eaton business.
    b. Flex-Strut Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Buckaroos, Inc.
2. Carpenter & Paterson, Inc.
3. Clement Support Services.
4. National Pipe Hanger Corporation.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

M. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

1. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

N. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

O. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

P. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

Q. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

R. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

S. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

T. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Roof drains and rainwater leaders.
4. Sanitary drain piping receiving condensate.
5. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated and for each application. Include thermal conductivity, water-vapor permeance, thickness, and jackets (both factory- and field-applied, if any).

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Reject damaged, deteriorated, wet, or contaminated material and immediately remove from the site. Replace removed materials at no additional cost to Owner.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Insulation:

1. Pittsburgh-Corning.
2. Owens- Corning.
3. Certainteed.
4. Armacell.
5. Rubatex.
6. Knauf.
7. Johns Manville.

B. Jacketing:

1. Ceel-Co.
2. O'Brien.
3. Zeston.
4. Childers.
5. Pabco.

C. Adhesives:

1. Benjamin Foster.
2. Childers.
3. Vimasco.
4. B.E.H.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Density of 5.0 lbs/cubic foot.
2. K factor of 0.27 at 75 degrees F mean.
3. Maximum water vapor transmission of 0.17 per inch.
4. Must be listed for 25/50 flame/smoke spread of thickness used.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber, Preformed Pipe Insulation: Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. All-service jacket ASJ-SSL type factory applied jacketing.
2. 6 lbs/cu ft minimum density.
3. k-factor of 0.31 maximum at 200 degrees F mean.
4. 850 degree F service temperature.
5. 0.02 perm maximum Jacket permeance.

2.3 PIPE AND FITTING COVERS

A. Polyvinyl Chloride (PVC) Covers:

1. Ultraviolet resistant.
2. 0.020 inch minimum thickness.
3. Preformed to match outer diameter of insulation.
4. Preformed fitting covers, minimum 10 mil.

B. Aluminum (A) Covers:

1. ASTM B209, Alloy 3003 minimum.
2. 0.016-inch thickness.
3. Bright anodized or acrylic-coated smooth finish on exposed side.
4. 2-piece tee and ribless elbow covers in minimum 0.016-inch, preformed.
5. Provide moisture barrier backing and butt-joint with mastic seal for joining of adjacent sections.

2.4 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 MASTICS

A. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

2.6 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.7 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.

2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.10 SECUREMENTS

A. Bands:

1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

2.11 PROTECTIVE SHIELDING GUARDS

1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

B. Domestic Hot and Recirculated Hot Water Mains:

1. NPS 2 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 2-1/2 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.

C. Domestic Hot Water Supply and Return runouts (up to NPS 2 and not exceeding 12 feet in length from fixture shutoff valve back toward main line):

1. NPS 2 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

D. Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities (Handicapped Lavatory & Sinks P-Trap & Supply Lines):

1. All Pipe Sizes: Insulation shall be the following:

a. Insulate p-trap, tailpiece and water supplies on handicapped lavatories with white, Truebro Model 102, Zurn 8947 handi lav-guard, or approved equivalent insulating system to meet A.D.A. Requirements. Provide accessories for offset tailpiece as required.

E. Floor Drains, Traps, and aboveground Sanitary Drain Piping receiving HVAC condensate:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1/2 inch thick.
b. Mineral-Fiber, ¾ lb density, ductwrap insulation with aluminum foil vapor barrier, Type I: 2 inch thick.

F. Exposed Domestic Cold and Hot Water Piping.

1. All exposed domestic cold and hot water piping shall also have field install PVC jacket.

G. Sewer Waste and Vent Piping:

1. Where Contractor elects to use schedule 40 PVC waste and vent piping (in lieu of cast iron piping) (exposed, in furrings, or above ceilings) (vertical and horizontal lines) shall be insulated with 2" thick 3/4 # density fiberglass ductwrap insulation with aluminum foil vapor barrier. Insulation shall be sealed at all seams and joints. Insulation shall be installed with a foil backed adhesive tape around the diameter of the pipe with insulation at 24" on center intervals.

3.12 INDOOR, PIPING WITHIN CMU BLOCK WALLS PIPING INSULATION SCHEDULE

A. Domestic cold water, hot water and condensate drain lines shall be insulated with 1/2" thick flexible closed cell elastomeric thermal tube insulation as manufactured by Armaflex AP, Rubatex or prior approved equal. All joints are to be firmly butted together. All lap and butt joint strips are to be sealed in place with vapor barrier adhesive. Fittings are to be mitered segments of insulation held in place with vapor barrier sealant. Engineered Polymer Foam Insulation (EPFI) will not be accepted.

3.13 INDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

A. Domestic cold and hot water lines run below slab within building shall be insulated with 1/2" thick flexible closed cell elastomeric thermal tube insulation as manufactured by Armaflex AP, Rubatex or prior approved equal.

B. All joints are to be firmly butted together. All lap and butt joint strips are to be sealed in place with vapor barrier adhesive. Fittings are to be mitered segments of insulation held in place with vapor barrier sealant.

C. Engineered Polymer Foam Insulation (EPFI) will not be accepted.

D. Apply two (2) coats of mastic on insulation.

3.14 OUTDOOR, ABOVE GROUND PIPING INSULATION SCHEDULE

A. All water lines on the outside of the building exposed to the weather shall be insulated with 1/2" thick flexible closed cell elastomeric thermal tube insulation as manufactured by Armaflex AP, Rubatex or prior approved equal.

B. All joints are to be firmly butted together. All lap and butt joint strips are to be sealed in place with vapor barrier adhesive. Fittings are to be mitered segments of insulation held in place with vapor barrier sealant.

C. Engineered Polymer Foam Insulation (EPFI) will not be accepted.

D. Apply two (2) coats of mastic on insulation.

E. Lines shall be covered with 0.016 smooth aluminum jacket and elbows. At contractor's option, in lieu of 0.016 aluminum jacket, the contractor may use Venture Clad 1577CW multi-layered laminate coated, acrylic pressure sensitive adhesive jacket system.

3.15 STORM DRAINAGE PIPING WITHIN BUILDING, ROOF DRAIN BODIES (ABOVE SLAB)

A. Shall be wrapped on outside with 2" thick, 3/4# density fiberglass insulation with aluminum foil vapor barrier. Insulation shall be taped at all joints and installed per manufacturer's recommendations.

3.16 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

1.3 ACTION SUBMITTALS

A. Product Data: For piping, transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

C. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Lead free Solder-joint.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Standard: ASSE 1079.
2. Pressure Rating: 150 psig.
3. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 220000 "Plumbing General Provisions" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance.

D. Install shutoff valve immediately upstream of each dielectric fitting.

E. Install domestic water piping level and plumb.

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

I. Install piping to permit valve servicing.

J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

M. Install sleeves for piping penetrations of walls, ceilings, and floors.

N. Install sleeve seals for piping penetrations of concrete walls and slabs.

O. Install escutcheons for piping penetrations of walls, ceilings, and floors.

P. Domestic cold water lines penetrating concrete slabs shall be wrapped with “Protect-O-Sleeve” vinyl flexible tube as manufactured by Robert H. Harris Co., Jones Stephen or equivalent.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition unions.

3.5 HANGER AND SUPPORT INSTALLATION

A. Provide pipe hangers and support products. Install as per the following:

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 IDENTIFICATION

A. Identify system components.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test

source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of available chlorine. Isolate with valves and allow to stand for 24 hours

(minimum time shall be 6 hours). A chlorine residual of at least 5 ppm should remain before the lines are put in use.

3. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   a. Repeat procedures if biological examination shows contamination.
   b. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Underground piping up to 5'-0" from building, domestic cold water, building-service piping, NPS 4 and smaller, shall be the following:
   1. PVC, Schedule 40; socket fittings; and solvent-cemented joints.

E. Aboveground domestic water piping, NPS 4 and smaller, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L; copper, solder-joint fittings; and soldered joints.

F. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be[**one of**] the following:
   1. soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball valves for piping NPS 3 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 4 and larger.
   2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 22 11 16

SECTION 22 11 19
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Water-hammer arresters.
3. Escutcheons
4. Trap-seal primer valves.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Standard: ASSE 1011.
2. Body: Bronze, non-removable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Chrome or nickel plated.

2.4 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. AMTROL, Inc.
   b. Precision Plumbing Products.
   c. Sioux Chief Manufacturing Company, Inc.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.
5. Plumbing fixtures with quick closing valves (i.e.: Dishwashers, Ice Maker, Tub/Shower Valve, Washing Machines, etc.) install "Shock Trol", "Precision Plumbing Products", Sioux Chief “Hydra-Rester”, or equal water Hammer arrester properly sized for each unit.

2.5 ESCUTCHEONS

A. Provide escutcheons for all exposed lines passing through floors, walls, and ceilings. They shall be chrome plated brass and shall be of such flange size as to cover necessary penetrating openings.

2.6 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
2. Size: NPS 1-1/4 minimum.
3. Material: Chrome-plated, cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install water-hammer arresters in water piping according to PDI-WH 201.

B. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

C. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

END OF SECTION

SECTION 22 12 19

NATURAL GAS DISTRIBUTION AND PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SERVICE

A. Contractor shall contact local utility company, determine the extent of their requirements and include in his price all costs required for the complete installation of gas service, meter and regulator.

B. Contractor shall include routing gas main from local utility main to the building and throughout project as indicated on Drawings.

C. Contractor shall provide gas pressure regulator downstream of the meter to provide adequate gas pressure to equipment furnished in project. Coordinate gas supply pressure and equipment supply pressure requirements with utility company and equipment manufacturers.

1.3 SUMMARY

A. Section Includes:

1. Natural gas pipes, tubes, and fittings in the buildings.

B. Product Data: For piping, transition fittings and dielectric fittings.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of natural gas distribution piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

3.2 HANGER AND SUPPORT INSTALLATION

A. Provide pipe hangers and support products. Install as per the following:

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

3.3 IDENTIFICATION

A. Identify system components.

B. All piping below grade shall be installed with a 14 Gauge tracer wire on complete system below grade. Tracer wire shall stub up at each pipe penetration from below grade and be secured to the pipe.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. All low pressure gas piping shall be tested with a 10" mercury column for thirty (30) minutes.
b. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
c. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
d. Prepare reports for tests and for corrective action required.

B. Natural gas water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Natural gas piping, NPS 4 and smaller, shall be the following:

1. Gas piping on the building interior of the building shall be standard black steel, Schedule 40, National Tube Co., or equal. Fittings which are 2 inches and below shall be malleable screw fittings. Piping above 2 inches shall be electrically welded utilizing weld fittings.
2. Gas piping on the exterior of the building and on the roof shall be the same as specified above, except to be coated with Scotch-Kote polyethylene coating (20 mil) and all joints weatherproofed with two coats of field applied Scotch-Kote wrapping tape.
3. Gas piping below grade shall be orange polyethylene pipe ASTM D-3350, PE 23533E with polyethylene butt fusion weld fittings.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. PVC pipe and fittings.
4. Encasement for underground metal piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, and details.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

1.6 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.
2. Waste, Force-Main Piping: 50 psig.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 PIPING MATERIALS

A. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) ® and listed by NSF International.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS (Above Grade)

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

D. Tensile Strength: 21,000 psig minimum.

E. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF International.

F. Each length of pipe and each fitting shall be plainly marked with size, country of origin, and name of manufacturer, or manufacturer’s registered trademark by which the manufacturer can be readily identified after installation.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS (Above Grade)

A. Pipe and Fittings: ASTM A 888 and CISPI 301.

B. Tensile Strength: 21,000 psig minimum.

C. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF International.

D. Each length of pipe and each fitting shall be plainly marked with size, country of origin, and name of manufacturer, or manufacturer’s registered trademark by which the manufacturer can be readily identified after installation.

E. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements. Provide products by one of the following:

   a. Ideal Tridon
   b. ANACO-Husky

2. Standards: CISPI 310.

3. Description: Shield Assemblies shall consist of stainless-steel bi-directional corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop. Couplings shall bear the trademark NSF International.

F. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements. Provide products by one of the following:
   a. Ideal Tridon
   b. ANACO-Husky

2. Standards: ASTM C 1540.

3. Description: Shield Assemblies shall consist of stainless-steel bi-directional corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 PVC PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40 will not be accepted.

D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns.

E. PVC Pressure Fittings: ASTM D 2466, Socket Type

F. Primer: ASTM F 656.

1. Primer shall have a VOC content of 550g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers”

G. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers”

2.6 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2. Unshielded, Nonpressure Transition Couplings:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Dallas Specialty & Mfg. Co.
      2) Fernco Inc.
      3) Mission Rubber Company, LLC; a division of MCP Industries.

   b. Standard: ASTM C 1173.

   c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

   d. End Connections: Same size as and compatible with pipes to be joined.

   e. Sleeve Materials:

      1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

3. Shielded, Nonpressure Transition Couplings:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cascade Waterworks Mfg. Co.
      2) Mission Rubber Company, LLC; a division of MCP Industries.

   b. Standard: ASTM C 1460.
   c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. End Connections: Same size as and compatible with pipes to be joined.

4. Pressure Transition Couplings:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Apollo Valves; a part of Aalberts Integrated Piping Systems.

2) EBAA Iron Sales, Inc.
3) Romac Industries, Inc.

b. Standard: AWWA C219.
c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
d. Center-Sleeve Material: Manufacturer's standard.
e. Gasket Material: Natural or synthetic rubber.
f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. Dielectric Unions:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) A.Y. McDonald Mfg. Co.
2) WATTS; A Watts Water Technologies Company.
3) Wilkins.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 150 psig.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

2. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Capitol Manufacturing Company.
2) WATTS; A Watts Water Technologies Company.
3) Zurn Industries, LLC.

b. Description:

1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 150 psig.
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

3. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Advance Products & Systems, LLC.
2) CALPICO, Inc.
3) GF Piping Systems: Georg Fischer LLC.
4) GPT; a division of EnPRO Industries.

b. Description:

1) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig.
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

4. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
2) Precision Plumbing Products.
3) Victaulic Company.

b. Description:

1) Standard: IAPMO PS 66.
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig at 225 deg F.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

2.7 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film manufactured of virgin polyethylene material conforming to the requirements of ASTM D 1248, and a minimum thickness of 0.008-inch thicknessor, high-density, cross-laminated polyethylene film manufactured of virgin polyethylene material conforming to the requirements of ASTM D 1248, and a minimum thickness of 0.004-inch.

C. Form: Sheet or, Tube

D. Color: Black or, Natural

E. Install polyethylene encasement for Hubless, Service, and Extra Heavy DWV cast iron pipe and fitting systems in accordance with ASTM A74, X3, and CISPI Handbook.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    a. Straight tees, elbows, and crosses may be used on vent lines.
3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install steel piping according to applicable plumbing code.

O. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.

P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

Q. Install aboveground PVC piping according to ASTM D 2665.

R. Install underground PVC piping according to ASTM D 2321.

S. Install engineered soil and waste and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

T. Install underground, ductile-iron, force-main piping according to AWWA C600.

1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
3. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

U. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."

1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

V. Install force mains at elevations indicated.

W. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping.

a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

3. Install drains in sanitary waste gravity-flow piping.

a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

X. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Y. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Z. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

AA. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. hreaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.

1. Cut threads full and clean using sharp dies.
2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
c. Do not use pipe sections that have cracked or open welds.

E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:

   a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
   b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. Comply with requirements in Section 220523 "General Duty Valves for Plumbing" for general-duty valve installation requirements.

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 and smaller.
3. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

F. Support vertical runs of cast iron soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.

4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect waste piping as indicated.

    a. Provide shutoff valve if indicated and union for each connection.
    b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 22 00 00 "Plumbing General Provisions."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections, and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.

a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
c. Air pressure must remain constant without introducing additional air throughout period of inspection.
d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.

a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.

a. Isolate test source and allow to stand for four hours.
b. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PREVENTIVE MAINTENANCE

A. All piping coming from parking deck drains shall be flushed with clean water for not

less than 10 minutes in each drain after winter season, and every 120 days. If chemicals are used to clean garage walls, this chemical shall be washed off the exterior of the pipe.

B. All piping from dedicated soda station floor sinks shall be flushed by dumping a basin of 5 gallons of warm clean water every 3rd day into the floor sink.

C. All piping connected to “low flow” fixtures shall be flushed with clean water by filling,and releasing a utility wash basin sink from the furthest point possible not less than once every 7 days.

3.12 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Solid Wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Solid Wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Solid Wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Floor drains.
3. Roof flashing assemblies.
4. Through-penetration firestop assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS - GENERAL

A. All floor drains shall be constructed of cast iron and shall be complete with clamping devices as required. The following numbers are taken from the Josam Catalog: Equivalent drains as manufactured by J.R. Smith, Zurn or Wade will be acceptable. NO OTHER MANUFACTURERS WILL BE ACCEPTED WITHOUT PRIOR APPROVAL. All floor drains shall be provided with 2# lead flashing extending a minimum of 24" all around drain except in certain areas where the General Contractor is providing a flashing membrane, in which case that membrane shall be flashed into the drain.

B. All floor drains shall be installed with deep seal p-traps.

2.2 CLEANOUTS:

A. Cleanouts other than type listed below as manufactured by J.R. Smith, Josam, Zurn and Wade, will not be acceptable.

B. Cleanouts shall be provided where shown on plans, at each change of direction of the building drain greater than 45 degrees and at or near the foot of each vertical waste or soil stack. Location of all cleanouts shall be the same size as the piping. Every cleanout shall be installed so that the cleanout opens in the direction of the flow of the drainage line or at right angle thereto.

C. Floor cleanouts shall be an adjustable type with anchor flange for clamp device, clamping collar and nickel bronze cover. Contractor shall install 2# lead flashing a minimum of 18" all around cleanout and flash into flange and anchor with clamping collar.

D. Top of cleanout shall be level with top of finished floor so there is a continuous surface.

E. Floor cleanouts shall be Zurn 1400, Wade W-6000, or J.R. Smith 4031 (NB) with adjustable scoriated secured nickel bronze top.

F. Wall cleanouts shall be nickel bronze access frame and cover, Josam 58770, Wade W-8560-E with W-8303-1, J. R. Smith 4735 access cover.

G. Outside cleanouts shall be as detailed on the Plans.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

a. Open-Top Vent Cap: Without cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
2. Size: Same as connected soil, waste, or vent stack.
3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
5. Special Coating: Corrosion resistant on interior of fittings.

2.5 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

E. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

F. Install deep-seal traps on floor drains and other waste outlets, if indicated.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

3.2 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 14 13

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of storm-drainage service.
2. Do not proceed with interruption of storm-drainage service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 PVC PIPE AND FITTINGS

A. Solid-Wall Schedule 40 PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe is **not acceptable**.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.

3. Shielded, Nonpressure Transition Couplings:
   a. Standard: ASTM C 1460.
   b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

N. Install aboveground PVC piping according to ASTM D 2665.

O. Install underground PVC piping according to ASTM D 2321.

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors.

R. Install sleeve seals for piping penetrations of concrete walls and slabs.

S. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices.

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

I. Install supports for vertical PVC piping every 48 inches.

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

A. Identify exposed storm drainage piping.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 48 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections, and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and require corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, storm drainage piping shall be the following:
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Underground, storm drainage piping shall be the following:
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.Retain "any of" option in first paragraph below to allow Contractor to select piping materials from those retained.

END OF SECTION

SECTION 22 14 23

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Through-penetration firestop assemblies.
5. Flashing materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. MIFAB, Inc.
   b. Zurn Industries, LLC.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: 24”x48”.
5. Combination Flashing Ring and Gravel Stop: Required.

6. Outlet: Bottom.
7. Extension Collars: Required.
8. Underdeck Clamp: Required.
9. Sump Receiver Plate: Required.
10. Dome Material: Cast iron.
11. Vandal-Proof Dome: Not required.
12. Water Dam: 2 inches high.

2.2 CLEANOUTS

A. Test Tees:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. MIFAB, Inc.
    b. Zurn Industries, LLC.
    c. Josam Company.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk or raised head, brass.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. ProSet Systems Inc.

2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: Refer to Architectural specifications for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

2.4 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M,12 oz./sq. ft..

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

C. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install horizontal backwater valves in floor with cover flush with floor.

G. Install drain-outlet backwater valves in outlet of drains.

H. Install test tees in vertical conductors and near floor.

I. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

J. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

K. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

L. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.

M. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during the remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 42 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Floor drains.
2. Water closets.
3. Flush valves.
4. Toilet seats.
5. Urinals.
6. Lavatories.
7. Sinks.
8. Hose bibs.
9. Electric Water Cooler.
10. Ice Machine Connection.
11. Refrigerator water connection box.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each of the plumbing fixtures.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flush valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 REFER TO PLUMBING FIXTURE SCHEDULE ON PLANS FOR ADDITIONAL INFORMATION.

2.2 REDUCED PRESSURE BACKFLOW PREVENTER: (1” HVAC MAKE-UP FOR C.W.)
1. Watts Series LF009QTS, Wilkins Series 975XL2TCU-S or equal lead free assembly with quarter turn ball valves and bronze strainer, stainless steel check seats, air gap drain connection and 1" Type "L" hard copper drain line to nearest floor drain. ASSE 1013.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine walls and floors for suitable conditions where plumbing fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Refer to Architectural Drawings for mounting height and exact location of all plumbing fixtures. Handicapped fixtures shall be installed to meet the latest A.D.A. requirements.

3.3 QUALITY

A. Plumbing Contractor shall furnish and install all plumbing fixtures shown on accompanying Drawings. Refer to both Plumbing and Architectural, and provide all fixtures shown on either. Fixtures shall be complete with all necessary brass and accessories required for a complete installation, including traps, escutcheons, angle supplies, basin cocks, etc. All fixtures shall be new and must be delivered to the building properly crated in perfect condition.

B. All brass must be of the best quality. Lightweight goods will not be accepted.

C. All brass pipe shall be seamless brass tubing and nipples shall be extra heavy.

D. All fittings and trim shall be chromium plated heavy brass unless otherwise specified.

E. "P" traps on lavatories and sinks shall be cast brass with cleanouts.

F. All exposed piping shall be chromium plated.

G. Provide cut-off valves at each fixture in both hot and cold water piping.

H. For the purpose of establishing type and class of fixtures required, the following plate numbers have been taken from the Manufacturer’s Catalog as indicated: Other fixture manufacturer's and model numbers, with prior approval, will be acceptable, however fixtures and accessories shall meet standards and features indicated below.

I. Contractor shall install silicon caulk around the base of a plumbing fixture or around the perimeter of a plumbing fixture where it attaches to a wall. The color of the caulk shall match the color of the plumbing fixture or shall be a color selected by the architect. Verify final color prior to installation. Caulked joint shall be properly smoothed out and shall completely seal the joint between the plumbing fixture and the surface the fixture is attached to. Unacceptable applications shall be completely removed and re-applied in accordance with directions from the architect.

J. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.

2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

K. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

L. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

M. Install toilet seats on water closets.

N. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

O. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.4 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.5 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.6 CLEANING AND PROTECTION

A. Clean plumbing fixtures and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed plumbing fixtures and fittings.

C. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 00

SECTION 22 6119 - COMPRESSED-AIR EQUIPMENT FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Oil-Less Scroll air compressors.

B. Related Requirements:

1. Section 226400 "Medical Gas Alarms" for compressed-air equipment local alarms.

1.3 DEFINITIONS

A. Actual Air: Air delivered at air-compressor outlet. Flow rate is compressed air delivered and measured in acfm.

B. Laboratory Air Equipment: Compressed-air equipment and accessories for nonmedical laboratory facilities.

C. Medical air equipment includes medical and healthcare laboratory air compressors and accessories for healthcare facilities.

D. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For air compressors, compressed-air dryers,.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Seismic Qualification Certificates: For air compressors, accessories, and components from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressed-air equipment to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Air-Compressor, Inlet-Air Filter Elements: Equal to 100 percent of quantity installed, but no fewer than 2 units.
2. Belts: Two for each belt-driven compressor.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Laboratory Air Equipment for Nonmedical Laboratory Facilities: An employer of workers trained and approved by manufacturer.
2. Medical Air Equipment for Healthcare Facilities: Qualify installers according to ASSE 6010.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the compressed-air equipment testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design compressed-air equipment mounting.

2.2 GENERAL REQUIREMENTS FOR AIR COMPRESSORS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 99, "Health Care Facilities," for compressed-air equipment and accessories for medical compressed-air systems.

C. Comply with UL 544, "Medical and Dental Equipment," for medical compressed-air equipment.

D. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.

E. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.

1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
2. Motor Controllers: Full-voltage, combination-magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
3. Control Voltage: 120-V ac or less, using integral control power transformer.
4. Motor Overload Protection: Overload relay in each phase.
5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
6. Automatic control switches to alternate lead-lag air compressors for duplex air compressors.
7. Instrumentation: Include discharge-air and receiver pressure gages, air-filter maintenance indicator, hour meter, air-compressor discharge-air and coolant temperature gages, and control transformer.
8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.

F. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1. Pressure Rating: At least as high as highest discharge pressure of connected air compressors and bearing appropriate code symbols.
2. Interior Finish: Corrosion-resistant coating.
3. Accessories: Include safety valve, pressure gage, automatic drain, and pressure regulator.

G. Mounting Frame: Fabricate base and attachment to air compressor and components with reinforcement strong enough to resist movement during a seismic event when base is anchored to building structure.

2.3 RECIPROCATING AIR COMPRESSORS

A. Oil-Free, Reciprocating Air Compressors <**Insert drawing designation**>:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Description: Packaged unit.
3. Air Compressor(s): Oil-free, reciprocating-piston type with nonlubricated compression chamber and lubricated crankcase, and of construction that prohibits oil from entering compression chamber.

    a. Submerged gear-type oil pump, and oil filter.
    b. Intercooler between stages of two-stage units.
    c. Combined high discharge-air temperature and low lubrication-oil pressure switch.
    d. Belt guard totally enclosing pulleys and belts.

4. Receiver and accessories.

B. Oilless, Reciprocating Air Compressors <**Insert drawing designation**>:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Description: Packaged unit.
3. Air Compressor(s): [**Single**] [**or**] [**two**]-stage, oilless (nonlubricated), reciprocating-piston type, with sealed oil-free bearings, that will deliver air of quality equal to intake air.

    a. High discharge-air temperature switch.
    b. Belt guard totally enclosing pulleys and belts.
    c. Intercooler between stages of two-stage units.

4. Receiver and accessories.

C. Capacities and Characteristics:

1. Compressed-Air Service: [**Medical**] [**Dental**] [**Instrument**] [**Medical laboratory**] [**Nonmedical laboratory**] <**Insert service**> air.
2. Air Compressor(s): [**One**] [**Two**] [**Three**] <**Insert number**>.
3. Standard-Air Capacity of Each Air Compressor: <**Insert scfm**> free air.
4. Actual-Air Capacity of Each Air Compressor: <**Insert acfm**> delivered.
5. Discharge-Air Pressure: [**80 psig**] [**125 psig**] [**175 psig**] <**Insert value**>.
6. Intake-Air Temperature: <**Insert deg F**>.
7. Discharge-Air Temperature: <**Insert deg F**>.
8. Mounting: [**Freestanding**] [**Tank mounted**].
9. Motor (Each Air Compressor):

    a. Horsepower: <**Insert value**>.
    b. Speed: [**1750**] [**3400**] <**Insert speed**> rpm.

10. Electrical Characteristics:

    a. Volts: <**Insert value**>.
    b. Phase(s): [**Single**] [**Three**].
    c. Hertz: [**60**] <**Insert value**>.
    d. Full-Load Amperes: <**Insert value**>.
    e. Minimum Circuit Ampacity: <**Insert value**>.

f. Maximum Overcurrent Protection: <**Insert amperage**>.

11. Receiver:

a. Orientation: [**Horizontal**] [**Vertical**] arrangement.
b. Capacity: <**Insert gal.** >.
c. Interior Finish: [**Epoxy**] [**Epoxy or galvanized**] [**Galvanized**] <**Insert coating**>.
d. Pressure Rating: [**100 psig**] [**125 psig**] [**150 psig**] [**200 psig**] <**Insert value**> minimum.
e. Pressure Regulator Setting: <**Insert psig**>.
f. Pressure Relief Valve Setting: <**Insert psig**>.
g. Drain: [**Automatic**] [**Manual**] valve.

2.4 ROTARY-SCREW AIR COMPRESSORS

A. Rotary-Screw Air Compressors <**Insert drawing designation**>:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Description: Packaged unit.
3. Air Compressor(s): Single-stage, oil-free, rotary-screw type with nonlubricated helical screws and lubricated gearbox, and of construction that prohibits oil from entering compression chamber.

a. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package prepiped to unit; with air-pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal-bypass valve.
b. Air Filter: Dry type, with maintenance indicator and cleanable replaceable filter element.
c. Air/Coolant Receiver and Separation System: 150-psig-rated steel tank with ASME safety valve, coolant-level gage, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal-bypass valve.
d. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating pressures between 50 and 100 psig. Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using pressure switch and blowdown valve.
e. Mounting: Freestanding.

4. Sound-attenuation enclosure.

B. Capacities and Characteristics:

1. Compressed-Air Service: [**Medical**] [**Dental**] [**Instrument**] [**Medical laboratory**] [**Nonmedical laboratory**] <**Insert service**> air.
2. Air Compressor(s): [**One**] [**Two**].
3. Standard-Air Capacity of Each Air Compressor: <**Insert scfm**> free air.
4. Actual-Air Capacity of Each Air Compressor: <**Insert acfm**> delivered.
5. Discharge-Air Pressure: [**80 psig**] [**110 psig**] <**Insert value**>.
6. Intake-Air Temperature: <**Insert deg F**>.
7. Discharge-Air Temperature: <**Insert deg F**>.
8. Motor (Each Air Compressor):

a. Horsepower: <**Insert value**>.

b. Speed: [**1750**] [**3400**] <**Insert speed**> rpm.

9. Electrical Characteristics:

a. Volts: <**Insert value**>.
b. Phase(s): [**Single**] [**Three**].
c. Hertz: [**60**] <**Insert value**>.
d. Full-Load Amperes: <**Insert value**>.
e. Minimum Circuit Ampacity: <**Insert value**>.
f. Maximum Overcurrent Protection: <**Insert amperage**>.

10. Receiver: ASME construction steel tank.

a. Orientation: [**Horizontal**] [**Vertical**] arrangement.
b. Capacity: <**Insert gal.** >.
c. Interior Finish: [**Epoxy**] [**Epoxy or galvanized**] [**Galvanized**] <**Insert coating**>.
d. Pressure Rating: [**100 psig**] [**125 psig**] [**150 psig**] <**Insert value**> minimum.
e. Pressure Regulator Setting: <**Insert psig**>.
f. Pressure Relief Valve Setting: <**Insert psig**>.
g. Drain: [**Automatic**] [**Manual**] valve.

2.5 SCROLL AIR COMPRESSORS

A. Oil-Less Scroll Air Compressors:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Pattons Medical. Model 62-22-072C
b. Tri-Tech Medical.

2. Description: Packaged unit.
3. Air Compressor(s): Single-stage, oil-free, scroll, oscillating-volute type of construction that prohibits oil from entering compression chamber.

a. Mounting: Freestanding.

B. Capacities and Characteristics:

1. Compressed-Air Service: Medical air.
2. Air Compressor(s): Two.
3. Standard-Air Capacity of Each Air Compressor: 24 icfm Inlet Cubic Feet per Minute free air.
4. Discharge-Air Pressure: 120 psig.
5. Motor (Each Air Compressor):

a. Horsepower: 7.5.
b. Speed: 3600 rpm.

6. Electrical Characteristics:

a. Volts: 460.
b. Phase(s): Three.
c. Hertz: 60.
d. Full-Load Amperes: 19.

7. Receiver: ASME construction steel tank.

a. Orientation: Vertical arrangement.
b. Capacity: 80 gallon.
c. Interior Finish: Epoxy.
d. Pressure Rating: 200 psig minimum.
e. Pressure Regulator Setting: 120 psig.
f. Drain: Automatic timed solenoid drain and Manual valve.

2.6 INLET-AIR FILTERS

A. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.

1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
2. Capacity: Match capacity of air compressor, with collection efficiency of 99 percent retention of particles larger than 10 micrometers.

B. Description: Combination inlet-air filter-silencer, suitable for remote installation, for multiple air compressors.

1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
2. Capacity: Match total capacity of connected air compressors, with collection efficiency of 99 percent retention of particles larger than 10 micrometers.

2.7 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Enclosure: Open, drip proof.
2. Unusual Service Conditions:

a. Ambient Temperature: 105 deg F.
b. High humidity.

3. Efficiency: Premium efficient.
4. NEMA Design: Open drip proof.
5. Service Factor: 1.15 value.
6. Electrical Characteristics:

a. Horsepower: 7.5.

b. Volts: 460.
c. Phase: 3.
d. Hertz: 60.
e. Full-Load Amperes: 19.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean compressed-air equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for laboratory air and medical air applications, according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."

3.2 COMPRESSED-AIR EQUIPMENT INSTALLATION

A. General Requirements for Compressed-Air Equipment Installation:

1. Install compressed-air equipment to allow maximum headroom unless specific mounting heights are indicated.
2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces unless otherwise indicated.
3. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
4. Install equipment to allow right of way for piping installed at required slope.
5. Install the following devices on compressed-air equipment:

    a. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
    b. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.
    c. Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

B. Medical Compressed-Air Equipment Installation:

1. Install according to ASSE 6010 and NFPA 99.
2. Install compressed-air equipment, except wall-mounted equipment, on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."
3. Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment"
4. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

3.3 CONNECTIONS

A. Comply with requirements for water-supply piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for drain piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Comply with requirements for compressed-air piping specified in Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities." Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

E. Connect compressed-air piping to compressed-air equipment, accessories, and specialties with shutoff valve and union or flanged connection.

F. Connect water supply to compressed-air equipment that requires water. Include backflow preventer. Backflow preventers are specified in Section 221119 "Domestic Water Piping Specialties."

3.4 IDENTIFICATION

A. Identify nonmedical laboratory compressed-air equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Identify medical compressed-air equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment." and with NFPA 99.

3.5 FIELD QUALITY CONTROL FOR HEALTHCARE-FACILITY MEDICAL COMPRESSED-AIR EQUIPMENT

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Medical Compressed-Air Equipment Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air equipment concurrently with tests, inspections, and certification of medical vacuum equipmen,t medical vacuum piping, medical compressed-air piping and medical gas piping systems.
2. Preparation: Perform medical compressed-air equipment tests according to requirements in NFPA 99 for the following:

    a. Air-quality purity test.
    b. System operation test.

3. Equipment Verification: Comply with requirements in ASSE 6020, ASSE 6030, and NFPA 99 for verification of medical compressed-air equipment.
4. Replace damaged and malfunctioning controls and equipment.
5. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

    a. Inspections performed.
    b. Procedures, materials, and gases used.
    c. Test methods used.
    d. Results of tests.

D. Components will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check for lubricating oil in lubricated-type equipment.
3. Check belt drives for proper tension.
4. Verify that air-compressor inlet filters and piping are clear.
5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
7. Check for proper seismic restraints.
8. Drain receiver tank(s).
9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
10. Test and adjust controls and safeties.

B. Prepare written report documenting testing procedures and results.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, compressed-air dryers and compressed-air filter assemblies.

END OF SECTION 22 61 19

SECTION 22 62 13

VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Medical-surgical vacuum piping, designated "medical vacuum."
2. Waste anesthetic gas disposal piping, designated "WAGD."

B. Related Requirements:
1. Section 226219 "Vacuum Equipment for Laboratory and Healthcare Facilities" for vacuum producers and accessories.
2. Section 226400 "Medical Gas Alarms" for vacuum piping alarms.

1.3 DEFINITIONS

A. HVE: High-volume (oral) evacuation.

B. WAGD: Waste anesthetic gas disposal.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Material Certificates: Signed by Installer certifying that medical vacuum piping materials comply with requirements in NFPA 99.

C. Brazing certificates.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For vacuum piping specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical vacuum suction inlets.

a. Medical Vacuum: Equal to 50 percent of amount installed, but no fewer than 5 units.
b. WAGD: Equal to 50 percent of amount installed, but no fewer than 5 units.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Medical Vacuum Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.
2. Pressure-Seal Joining Procedure for Copper Tubing: An authorized representative who is trained and approved by manufacturer.
3. Extruded-Tee Outlet Procedure: An authorized representative who is trained and approved by manufacturer.
4. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Medical vacuum operating at 15 in. Hg.

B. WAGD operating at 15 in. Hg.

2.2 PIPES, TUBES, AND FITTINGS

A. Comply with NFPA 99 for medical vacuum piping materials.

B. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.

C. Copper Water Tube: ASTM B 88, Type M, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service.

D. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service.

E. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.

F. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.

1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, full-face type.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

G. Shape-Memory-Metal Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Aerofit, Inc.
b. CAMERON; A Schlumber Co.
c. Motion Industries.
d. Smart Tap; Smart Technology, Inc.

2. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.

H. Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. FNW; Ferguson Enterprises, Inc.
b. NIBCO INC.
c. Viega LLC.

2. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
3. NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

I. Extruded-Tee Outlets: ASTM F 2014 procedure for making branch outlets in copper tube.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. T-DRILL Industries Inc.

J. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.

K. PVC Fittings: ASTM D 2466, Schedule 40 and ASTM D 2467, Schedule 80; socket type.

L. Transition Fittings: PVC socket type with copper threaded insert on one end.

M. Flexible Pipe Connectors:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Flex-Hose Co., Inc.
   b. Flexicraft Industries.
   c. Universal Metal Hose.

2. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

   a. Working-Pressure Rating: 200 psig minimum.
   b. End Connections: Plain-end copper tube.

2.3 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.

C. Threaded-Joint Tape: PTFE.

D. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 VALVES

A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.

1. Exception: Factory cleaning and bagging are not required for valves for WAGD service.

B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.

1. Zone-Valve Boxes:

a. Steel Box with Stainless-Steel Cover:

1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a) Amico Corporation.
b) BeaconMedaes.
c) Tri-Tech Medical.

b. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.

1) Interior Finish: Factory-applied white enamel.
2) Cover Plate: Aluminum or stainless-steel with frangible or removable windows.
3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

C. Copper-Alloy Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amico Corporation.
b. BeaconMedaes.
c. Tri-Tech Medical.

2. Standard: MSS SP-110.
3. Description: Three-piece body, brass or bronze.
4. Pressure Rating: 300 psig minimum.
5. Ball: Full-port, chrome-plated brass.
6. Seats: PTFE or TFE.
7. Handle: Lever type with locking device.
8. Stem: Blowout proof with PTFE or TFE seal.
9. Ends: manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Amico Corporation.
b. BeaconMedaes.
c. Tri-Tech Medical.

2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

2.5 MEDICAL VACUUM SERVICE CONNECTIONS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Amico Corporation.
2. BeaconMedaes.
3. Tri-Tech Medical.

B. General Requirements for Medical Vacuum Service Connections:

1. Suitable for specific medical vacuum service listed.
2. Include roughing-in assemblies, finishing assemblies, and cover plates.
3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
4. Recessed-type units made for concealed piping unless otherwise indicated.

C. Roughing-in Assembly:

1. Steel outlet box for recessed mounting and concealed piping.
2. Brass-body inlet block.
3. Seals that will prevent vacuum leakage.
4. ASTM B 819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.

D. Finishing Assembly:

1. Brass housing with primary check valve.
2. Seals that will prevent vacuum leakage.
3. Cover plate with gas-service label.

E. Quick-Coupler Suction Service Connections:

1. Inlets for medical vacuum and WAGD with noninterchangeable keyed indexing to prevent interchange between services.
2. Constructed to permit one-handed connection and removal of equipment.
3. With positive-locking ring that retains equipment stem in valve during use.

F. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.

G. Cover Plates:

1. One piece.
2. Aluminum or stainless steel.
3. Permanent, color-coded, identifying label matching corresponding service.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:

1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.

    a. Scrub to ensure complete cleaning.
    b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, vacuum producer sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Comply with NFPA 99 for installation of vacuum piping.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install vacuum piping with 1 percent slope downward in direction of flow.

H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

I. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

J. Provide drain leg and drain trap at end of each main and branch and at low points.

K. Install thermometer and vacuum gage on inlet piping to each vacuum producer and on each receiver and separator. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."

L. Install piping to permit valve servicing.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.

O. Install medical vacuum piping from medical vacuum service connections specified in this Section, to equipment specified in Section 226219 "Vacuum Equipment for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical vacuum service.

P. Install medical vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

Q. Install medical vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.

R. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.

S. Install unions in copper vacuum tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

T. Install unions in PVC vacuum piping NPS 2 and smaller adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

U. Install flanges in PVC vacuum piping NPS 2-1/2 and larger adjacent to flanged valves and at final connection to each machine, specialty, and piece of equipment.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 VALVE INSTALLATION

A. Install shutoff valve at each connection to and from vacuum equipment and specialties.

B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Apply appropriate tape to external pipe threads.

E. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.

F. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Join copper tube and fittings according to ASTM B 828.

G. PVC-to-Copper Joints: Join transition fitting PVC socket end as solvent-cemented joint to PVC pipe and join fitting end with insert to copper tube as threaded joint.

H. Extruded-Tee Outlets: Form branches in copper tube according to ASTM F 2014, with tools recommended by tube manufacturer.

I. Flanged Joints:

1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
2. PVC Piping: Install PVC flange on PVC pipes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

J. Pressure-Sealed Joints: Join copper tube and copper and copper-alloy fittings with tools recommended by fitting manufacturer.

K. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

L. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. Apply primer and join according to ASME B31.9 and ASTM D 2672 for solvent-cemented joints.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or Type 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches of each fitting and coupling.

H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch-minimum rods.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4: 60 inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
3. NPS 3/4: 84 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.
8. NPS 2-1/2: 13 feet with 1/2-inch rod.
9. NPS 3: 14 feet with 1/2-inch rod.
10. NPS 3-1/2: 15 feet with 1/2-inch rod.
11. NPS 4: 16 feet with 1/2-inch rod.
12. NPS 5: 18 feet with 1/2-inch rod.
13. NPS 6: 20 feet with 5/8-inch rod.
14. NPS 8: 23 feet with 3/4-inch rod.

J. Install supports for vertical copper tubing every 10 feet.

3.6 IDENTIFICATION

A. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Install identifying labels and devices for medical vacuum piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:

1. Medical Vacuum: Black letters on white background.
2. WAGD: White letters on violet background.

3.7 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL VACUUM PIPING

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections of medical vacuum piping systems in healthcare facilities and to prepare test and inspection reports.

B. Tests and Inspections:

1. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical gas piping systems.
2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:

    a. Initial blowdown.
    b. Initial pressure test.
    c. Cross-connection test.
    d. Piping purge test.
    e. Standing pressure test for vacuum systems.
    f. Repair leaks and retest until no leaks exist.

3. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:

    a. Standing pressure test.
    b. Individual-pressurization or pressure-differential cross-connection test.
    c. Valve test.
    d. Master and area alarm tests.
    e. Piping purge test.
    f. Final tie-in test.
    g. Operational vacuum test.
    h. Verify correct labeling of equipment and components.

4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

    a. Inspections performed.
    b. Procedures, materials, and gases used.
    c. Test methods used.
    d. Results of tests.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.8 FIELD QUALITY CONTROL FOR LABORATORY FACILITY NONMEDICAL VACUUM PIPING

A. Testing Agency: Engage qualified testing agency to perform field tests and inspections of vacuum piping in nonmedical laboratory facilities and to prepare test and inspection reports.

B. Tests and Inspections:

1. Piping Leak Tests for Vacuum Piping: Test new and modified parts of existing piping. Cap and fill vacuum piping with oil-free, dry nitrogen. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.

a. Test Pressure for Copper Tubing: 150 psig <**Insert value**>.

2. Repair leaks and retest until no leaks exist.
3. Inspect filters for proper operation.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.9 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.10 PIPING SCHEDULE

A. Flanges may be used where connection to flanged equipment is required.

B. Medical Vacuum Piping: Use copper medical gas tube, wrought-copper fittings, and brazed joints.

C. WAGD Piping: Use copper medical gas tube, wrought-copper fittings, and brazed joints.

3.11 VALVE SCHEDULE

A. Shutoff Valves:

1. Copper Tubing: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
2. PVC Piping:

a. NPS 4 and Smaller: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.

B. Zone Valves: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION 22 62 13

SECTION 22 62 19

VACUUM EQUIPMENT FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rotary, dry-claw vacuum pumps.

B. Related Requirements:

1. Section 226400 "Medical Gas Alarms" for vacuum equipment local alarms.

1.3 DEFINITIONS

A. Actual Air: Air delivered at vacuum producer inlet. Flow rate is air measured in acfm.

B. HVE: High-volume oral evacuation for dental applications in healthcare facilities.

C. Laboratory Vacuum Equipment: Vacuum producers and accessories for nonmedical laboratory facilities.

D. Medical Vacuum Equipment: Includes medical WAGD vacuum producers and accessories for healthcare facilities.

E. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

F. WAGD: Waste anesthetic gas disposal for medical-surgical applications in healthcare facilities.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For vacuum producers.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Seismic Qualification Certificates: For vacuum producers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For vacuum equipment to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: Two for each belt-driven vacuum producer.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Laboratory Vacuum Equipment for Nonmedical Laboratory Facilities: An employer of workers trained and approved by manufacturer.
2. Medical Vacuum Equipment for Healthcare Facilities: Qualify installers according to ASSE 6010.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum equipment testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vacuum equipment mounting.

2.2 GENERAL REQUIREMENTS FOR VACUUM PUMPS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 99, "Health Care Facilities," for vacuum equipment and accessories for medical vacuum systems.

C. Comply with UL 544, "Medical and Dental Equipment," for medical vacuum equipment.

D. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty vacuum pumps and receivers.

E. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.

1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
2. Motor Controllers: Full-voltage, combination-magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
3. Control Voltage: 120-V ac or less, using integral control power transformer.
4. Motor Overload Protection: Overload relay in each phase.
5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
6. Automatic control switches to alternate lead-lag vacuum pumps for duplex vacuum pumps.
7. Instrumentation: Include vacuum pump inlet and receiver vacuum gages, hour meter, vacuum pump discharge-air and coolant temperature gages, and control transformer.
8. Alarm Signal Devices: For connection to alarm system to indicate when backup vacuum pump is operating.

F. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1; bearing appropriate code symbols.

1. Interior Finish: Corrosion-resistant coating.
2. Accessories: Include vacuum relief valve, vacuum gage, and drain.

G. Mounting Frames: Fabricate base and attachment to vacuum pump and components with reinforcement strong enough to resist movement during a seismic event when base is anchored to building structure.

2.3 ROTARY, DRY-CLAW VACUUM PUMPS

A. Rotary, Dry-Claw Vacuum Pumps:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Pattons Medical. Model 74L-25-103C
    b. Tri-Tech Medical.

2. Description: Packaged unit. NFPA fully compliant
3. Vacuum Pump(s): Duplex, rotary, oil-less claw type.

    a. Coupling: Nonlubricated, flexible type.
    b. Cooling System: Air cooled.
    c. Capacity Control: Capacity modulation between zero and 100 percent vacuum delivery. Include necessary control to hold constant vacuum. When vacuum demand is zero, unload unit by using vacuum switch and blowdown valve.

4. Receiver: ASME construction steel tank with vacuum relief valve.
5. Outlet silencers on discharge connections.

B. Capacities and Characteristics:

1. Vacuum Service: Medical vacuum.
2. Vacuum Pump(s): Two.
3. Standard-Air Capacity of Each Vacuum Pump: 87 scfm free air.
4. Vacuum Required: 19 in. Hg.
5. Motor (Each Vacuum Pump): NEMA rated, C-Face, TEFC

    a. Horsepower: 10.
    b. Speed: 3600 rpm

6. Electrical Characteristics:

    a. Volts: 460.
    b. Phase(s): Three.
    c. Hertz: 60.
    d. Full-Load Amperes: 25.

7. Receiver:

    a. Orientation: Vertical arrangement. Vertical tank mount.
    b. Capacity: 120 gallons.
    c. Pressure Rating: 200 psig minimum.
    d. Interior Finish: Epoxy corrosion resistant.
    e. Drain: Manual valve.
    f. Bypass: 3 valve.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Enclosure: Totally enclosed, fan cooled.
2. Unusual Service Conditions:

a. Ambient Temperature: 105 deg F. maximum
b. High humidity.

3. Efficiency: Premium efficient.
4. NEMA Design: NEMA rated, C-Face, TEFC
5. Service Factor: 1.15
6. Electrical Characteristics:

a. Horsepower: 10.
b. Volts: 460.
c. Phase: 3.
d. Hertz: 60.
e. Full-Load Amperes: 25.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean vacuum equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for medical vacuum applications, according to CGA G4.1, "Cleaning Equipment for Oxygen Service."

3.2 VACUUM EQUIPMENT INSTALLATION

A. Install vacuum equipment for healthcare facilities according to ASSE 6010 and NFPA 99.

B. Equipment Mounting:

1. Install vacuum producers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

C. Install vacuum equipment anchored to substrate.

D. Orient equipment so controls and devices are accessible for servicing.

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Install the following devices on vacuum equipment:

1. Thermometer, Vacuum Gage, and Pressure Relief Valve: Install on each vacuum pump receiver.
2. Drain Valves: Install on receivers and separators. Discharge receiver condensate over nearest floor drain. Discharge separator oral evacuation fluids by direct connection into sanitary waste piping system.

3.3 CONNECTIONS

A. Comply with requirements for water-supply piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for drain piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Comply with requirements for vacuum piping specified in Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities." Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

E. Connect vacuum piping to vacuum equipment, accessories, and specialties with shutoff valve and union or flanged connection.

F. Connect water supply to vacuum equipment that requires water. Include backflow preventer. Backflow preventers are specified in Section 221119 "Domestic Water Piping Specialties."

3.4 IDENTIFICATION

A. Identify nonmedical laboratory vacuum equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Identify medical vacuum equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment." and with NFPA 99.

3.5 FIELD QUALITY CONTROL FOR HEALTHCARE-FACILITY MEDICAL VACUUM EQUIPMENT

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Medical Vacuum Equipment Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum equipment concurrently with tests, inspections, and certification of medical compressed-air equipment, medical compressed-air piping, medical vacuum piping and medical gas piping systems.
2. Preparation: Perform medical vacuum equipment tests according to requirements in NFPA 99 for the following:

    a. System operation test.

3. Equipment Verification: Comply with requirements in ASSE 6020, ASSE 6030, and NFPA 99 for verification of medical vacuum equipment.
4. Replace damaged and malfunctioning controls and equipment.
5. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

    a. Inspections performed.
    b. Procedures and materials used.
    c. Test methods used.

d. Results of tests.

D. Components will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check for lubricating oil in lubricated-type equipment.
3. Check belt drives for proper tension.
4. Verify that vacuum producer outlet piping is clear.
5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
6. Check safety valves for correct settings.
7. Check for proper seismic restraints.
8. Drain receiver and separator tank(s).
9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
10. Test and adjust controls and safeties.

B. Verify that vacuum equipment is installed and connected according to the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in electrical Sections.

D. Prepare written report documenting testing procedures and results.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain vacuum producers.

END OF SECTION 22 62 19

SECTION 22 63 13

GAS PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Oxygen piping, designated "medical oxygen."
2. Medical Air gas piping, designated "specialty medical air."

B. Related Requirements:

1. Section 226400 "Medical Gas Alarms" for combined medical air, vacuum, and gas alarms.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. Medical gas piping systems include medical oxygen and medical air for healthcare facility patient care.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Material Certificates: Signed by Installer certifying that medical gas piping materials comply with requirements in NFPA 99 for positive-pressure medical gas systems.

C. Brazing certificates.

D. Certificates of Shop Inspection and Data Report for Bulk Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For medical and specialty gas piping specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical gas pressure outlets and suction inlets.
   a. Medical Oxygen: Equal to 50 percent of quantity installed, but no fewer than 5 units.
   b. Medical Air: Equal to 50 percent of quantity installed, but no fewer than 5 units.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Medical Gas Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.
2. Bulk Medical Gas Systems for Healthcare Facilities: According to ASSE Standard #6015 for bulk-medical-gas-system installers.
3. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the medical gas piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Medical oxygen operating at 50 to 55 psig.

B. Medical air operating at 50 to 55 psig.

2.2 PIPES, TUBES, AND FITTINGS

A. Comply with NFPA 99 for medical gas piping materials.

B. Copper Medical Gas Tube: ASTM B 819, Type K and Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service; or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.

C. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.

D. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.

E. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.

1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, full-face type.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

F. Shape-Memory-Metal Couplings:

1. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.

2.3 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.

B. Threaded-Joint Tape: PTFE.

C. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

2.4 VALVES

A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.

B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.

1. Zone-Valve Boxes:

a. Steel Box with Stainless-Steel Cover:

1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a) Amico Corporation.
b) BeaconMedaes.
c) Tri-Tech Medical.

b. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.

1) Interior Finish: Factory-applied white enamel.
2) Cover Plate: Aluminum or stainless steel with frangible or removable windows.
3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amico Corporation.
b. BeaconMedaes.
c. Tri-Tech Medical.

2. Standard: MSS SP-110.
3. Description: Three-piece body, brass or bronze.
4. Pressure Rating: 300 psig minimum.
5. Ball: Full-port, chrome-plated brass.
6. Seats: PTFE or TFE.
7. Handle: Lever type with locking device.
8. Stem: Blowout proof with PTFE or TFE seal.
9. Ends: manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Amico Corporation.
b. BeaconMedaes.
c. Tri-Tech Medical.

2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

E. Emergency Oxygen Connections: Low-pressure oxygen inlet assembly for connection to building oxygen piping systems.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Amico Corporation.
b. BeaconMedaes.
c. Tri-Tech Medical.

2. Enclosure: Weatherproof hinged locking cover with caption similar to "Emergency Low-Pressure Gaseous Oxygen Inlet."
3. Inlet: Manufacturer-installed, NPS 1 or NPS 1-1/4, ASTM B 819, copper tubing with NPS 1 minimum ball valve.
4. Safety Valve: Bronze-body pressure relief valve set at 75 or 80 psig.
5. Instrumentation: Pressure gage.

F. Safety Valves:

1. Bronze body.
2. ASME-construction, poppet, pressure-relief type.
3. Settings to match system requirements.

G. Pressure Regulators:

1. Bronze body and trim.
2. Spring-loaded, diaphragm-operated, relieving type.
3. Manual pressure-setting adjustment.
4. Rated for 250-psig minimum inlet pressure.
5. Capable of controlling delivered gas pressure within 0.5 psig for each 10-psig inlet pressure.

2.5 MEDICAL GAS SERVICE CONNECTIONS

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Amico Corporation.
   b. BeaconMedaes.
   c. Tri-Tech Medical.

B. General Requirements for Medical Gas Service Connections:

1. Suitable for specific medical gas pressure and suction service listed.
2. Include roughing-in assemblies, finishing assemblies, and cover plates.
3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
4. Recessed-type units made for concealed piping unless otherwise indicated.

C. Roughing-in Assembly:

1. Steel outlet box for recessed mounting and concealed piping.
2. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed. Suction inlets to be without secondary valve.
3. Double seals that will prevent gas leakage.
4. ASTM B 819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.

D. Finishing Assembly:

1. Brass housing with primary check valve.
2. Double seals that will prevent gas leakage.
3. Cover plate with gas-service label.

E. Quick-Coupler Pressure Service Connections: Outlets for oxygen with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.

F. Quick-Coupler Pressure Service Connections: Outlets for medical air with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.

G. Quick-Coupler Suction Service Connections: Inlets for medical vacuum and WAGD with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.

H. Cover Plates: One piece, aluminum or stainless steel and permanent, color-coded, identifying label matching corresponding service.

2.6 MEDICAL GAS MANIFOLDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Amico Corporation.
   b. BeaconMedaes.
   c. Tri-Tech Medical.

B. Comply with NFPA 99 for high-pressure medical gas cylinders.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Central Control-Panel Unit:

   1. Weatherproof cabinet.
   2. Supply and delivery pressure gages.
   3. Electrical alarm-system connections and transformer.
   4. Indicator lights or devices.
   5. Manifold connection.
   6. Pressure changeover switch.
   7. Line-pressure regulator.
   8. Shutoff valves.
   9. Safety valve.

E. Manifold and Headers:

   1. Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks.
   2. Designed for 2000-psig minimum inlet pressure except nitrous oxide manifolds may be designed for 800 psig and carbon dioxide manifolds may be designed for 1500 psig.
   3. Cylinder-bank headers with inlet (pigtail) connections complying with CGA V-1.
   4. Individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.

F. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder-bank header.

G. Mounting: Wall with mounting brackets for manifold control cabinet and headers.

H. Label manifold control unit with permanent label identifying medical gas type and system operating pressure.

I. Medical Air Manifolds: For six cylinders and 55-psig line pressure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:

1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.

    a. Scrub to ensure complete cleaning.
    b. Rinse with clean, hot water to remove cleaning solution.

3.2 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling and for underground warning tapes.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Comply with NFPA 99 for installation of medical gas piping.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

H. Install piping to permit valve servicing.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and for branch connections.

K. Install medical gas piping to medical gas service connections specified in this Section, to medical gas service connections in equipment specified in this Section, and to equipment specified in other Sections requiring medical gas service.

L. Install exterior, buried medical gas piping in protective conduit fabricated with PVC pipe and fittings. Do not extend conduit through foundation wall.

M. Install medical gas service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

N. Connect gas piping to gas sources and to gas outlets and equipment requiring gas service.

O. Install unions in copper tubing adjacent to each valve and at final connection to each specialty and piece of equipment.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 VALVE INSTALLATION

A. Install shutoff valve at each connection to gas laboratory and healthcare equipment and specialties.

B. Install check valves to maintain correct direction of gas flow from laboratory and healthcare gas supplies.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gages in valve boxes. Arrange valves so largest valve is lowest. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install pressure regulators on gas piping where reduced pressure is required.

F. Install emergency oxygen connection with pressure relief valve and full-size discharge piping to outside, with check valve downstream from pressure relief valve, and with ball valve and check valve in supply main from bulk oxygen storage tank.

3.5 JOINT CONSTRUCTION

A. Ream ends of PVC pipes and remove burrs.

B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

C. Threaded Joints: Apply appropriate tape to external pipe threads.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Continuously purge joint with oil-free, dry nitrogen during brazing.

E. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

F. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. Apply primer and join according to ASME B31.9 and ASTM D 2672 for solvent-cemented joints.

3.6 GAS SERVICE COMPONENT INSTALLATION

A. Assemble patient-service console with service connections. Install with supplies concealed in walls. Attach console box or mounting bracket to substrate.

B. Install gas manifolds anchored to substrate.

C. Install gas cylinders and connect to manifold piping.

D. Install bulk gas storage tanks and reserve supply tanks level on concrete bases. Set tanks and connect gas piping to tanks according to applicable requirements in NFPA 50 for bulk oxygen storage systems. Install tanks level and plumb, firmly anchored to concrete bases; maintain NFPA 50 and tank manufacturer's recommended clearances. Orient tanks so controls and devices are accessible for servicing.

E. Install bulk gas storage tanks and reserve supply tanks with seismic restraints.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

B. Vertical Piping: MSS Type 8 or Type 42, clamps.

C. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.

D. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

E. Base of Vertical Piping: MSS Type 52, spring hangers.

F. Support horizontal piping within 12 inches of each fitting and coupling.

G. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch-minimum rods.

H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4: 60 inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
3. NPS 3/4: 84 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.
8. NPS 2-1/2: 13 feet with 1/2-inch rod.
9. NPS 3: 14 feet with 1/2-inch rod.
10. NPS 3-1/2: 15 feet with 1/2-inch rod.
11. NPS 4: 16 feet with 1/2-inch rod.
12. NPS 5: 18 feet with 1/2-inch rod.
13. NPS 6: 20 feet with 5/8-inch rod.
14. NPS 8: 23 feet with 3/4-inch rod.

I. Install supports for vertical copper tubing every 10 feet.

3.8 IDENTIFICATION

A. Install identifying labels and devices for specialty gas piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Install identifying labels and devices for healthcare medical gas piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:

1. Oxygen: White letters on green background or green letters on white background.
2. Medical Air: Black letters on yellow background.

3.9 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL GAS

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Medical Gas Piping Testing Coordination: Perform tests, inspections, verifications, and certification of medical gas piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical vacuum piping systems.
2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:

    a. Initial blowdown.
    b. Initial pressure test.
    c. Cross-connection test.
    d. Piping purge test.
    e. Standing pressure test for positive-pressure medical gas piping.
    f. Standing pressure test for vacuum systems.
    g. Repair leaks and retest until no leaks exist.

3. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:

    a. Standing pressure test.
    b. Individual-pressurization or pressure-differential cross-connection test.
    c. Valve test.
    d. Master and area alarm tests.
    e. Piping purge test.
    f. Piping particulate test.
    g. Piping purity test.
    h. Final tie-in test.
    i. Operational pressure test.
    j. Medical gas concentration test.
    k. Medical air purity test.
    l. Verify correct labeling of equipment and components.
    m. Verify medical gas supply sources.

4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

    a. Inspections performed.
    b. Procedures, materials, and gases used.
    c. Test methods used.
    d. Results of tests.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

D. Prepare test and inspection reports.

3.10 FIELD QUALITY CONTROL FOR LABORATORY FACILITY SPECIALTY GAS

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Specialty Gas Piping: Test new and modified parts of existing piping. Cap and fill specialty gas piping with oil-free, dry nitrogen to pressure of 50 psig

above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.

2. Repair leaks and retest until no leaks exist.
3. Inspect specialty gas regulators for proper operation.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

D. Prepare test and inspection reports.

3.11 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.12 DEMONSTRATION

A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain bulk gas storage tanks.

3.13 PIPING SCHEDULE

A. Connect new tubing to existing tubing with memory-metal couplings.

B. Medical Gas Piping except Medical Nitrogen Piping Larger Than NPS 3 and Operating at More Than 185 psig: Type L, copper tube; wrought-copper fittings; and brazed joints.

C. Protective Conduit: PVC pipe, PVC fittings, and solvent-cemented joints.

3.14 VALVE SCHEDULE

A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.

B. Zone Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION 22 63 13

SECTION 22 64 00

MEDICAL GAS ALARMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Master alarm panels.
2. Area alarm panels.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Product Test Reports: For each alarm panel, for tests performed by a qualified testing agency.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For alarm panels and computer-interface cabinet to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Qualify Installers for air, vacuum, and gas piping systems for healthcare facilities according to ASSE Standard #6010 for medical-gas-system installers.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the air, vacuum, and gas piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel for air, vacuum, and gas piping systems for healthcare facilities according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Gas and Vacuum Systems Monitored:
1. Medical compressed air, designated "medical air."
2. Medical-surgical vacuum, designated "medical vacuum."
3. Oxygen, designated "medical oxygen."
4. Waste anesthetic gas disposal, designated "WAGD."

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Amico Corporation.
b. BeaconMedaes.
c. Tri-Tech Medical.

B. Source Limitations: Obtain medical alarm systems and components from single manufacturer.

2.3 GENERAL REQUIREMENTS FOR ALARM PANELS

A. Description: Factory wired with audible and color-coded visible signals to indicate specified functions.

1. Mounting: Recessed installation.
2. Enclosures: Fabricated from minimum 0.047-inch-thick steel or minimum 0.05-inch-thick aluminum, with knockouts for electrical and piping connections.

B. Components: Designed for continuous service and to operate on power supplied from 120-V ac power source to alarm panels and with connections for low-voltage wiring to remote sensing devices. Include step-down transformers if required.

C. Dew Point Monitors: Continuous line monitoring, having panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, factory- or field-installed

valved bypass, and visual and cancelable audio signal for dryer site and master alarm panels. Alarm signals when pressure dew point rises above 39 deg F at 55 psig.

1. Operation: Chilled-mirror method or hygrometer moisture analyzer with sensor probe.

D. Pressure Switches or Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.

1. Low-Pressure Operating Range: 0 to 100 psig.
2. High-Pressure Operating Range: Up to 250 psig.

E. Carbon-Monoxide Monitors: Panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, and factory- or field-installed valved bypass. Alarm signals when carbon-monoxide level rises above 10 ppm.

F. Vacuum Switches or Pressure Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.

1. Vacuum Operating Range: 0 to 30 in. Hg.

2.4 MASTER ALARM PANELS

A. Master Alarm Panels: Separate trouble alarm signals and indicators for each system.

1. Standards: Comply with NFPA 99 and UL 544.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Include alarm signals when the following conditions exist:

    a. Medical Air: Pressure drops below 40 psig or rises above 60 psig, backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig, dew point rises above 39 deg F at 55 psig, carbon-monoxide level rises above 10 ppm, and high water level is reached in receiver for liquid-ring, medical air compressor systems.
    b. Medical Vacuum: Vacuum drops below 12 in. Hg and backup vacuum pump is in operation.
    c. WAGD: Vacuum drops below 12 in. Hg.
    d. Medical Oxygen: Liquid level is low, pressure downstream from main shutoff valve drops below 40 psig or rises above 60 psig, changeover is made to reserve, reserve is in use, reserve level is low, and reserve pressure is low.
    e. Medical Oxygen: Pressure downstream from main shutoff valve drops below 40 psig or rises above 60 psig and changeover is made to alternate bank.

2.5 AREA ALARM PANELS

A. Area Alarm Panels: Separate trouble alarm signals and indicators for each system.

1. Standards: Comply with NFPA 99 and UL 544.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Include alarm signals when the following condition exists:

a. Medical Air: Pressure drops below 40 psig or rises above 60 psig.
b. Medical Vacuum: Vacuum drops below 12 in. Hg.
c. Medical Oxygen: Pressure drops below 40 psig or rises above 60 psig.

PART 3 - EXECUTION

3.1 ALARM-PANEL INSTALLATION

A. Install alarm panels in locations required by and according to NFPA 99.

B. Install computer-interface cabinet with connection to alarm panels and facility computer.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities," Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities," and Section 226313 "Gas Piping for Laboratory and Healthcare Facilities." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to alarm panels, allow space for service and maintenance.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" and according to NFPA 99.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform each visual and mechanical inspection.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning panels and equipment.

D. Alarm panels will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

A. Adjust initial alarm panel pressure and vacuum set points.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain alarm panels.

END OF SECTION 22 64 00

SECTION 23 00 00

MECHANICAL GENERAL PROVISIONS

PART 1 GENERAL

1.01 SUMMARY

A. The General Conditions of the Architectural Specifications, along with the supplementary conditions, special conditions, information to bidders, and any other pertinent information and documents shall apply the same as if repeated herein.

1.02 SCOPE OF WORK

A. Furnish all labor and material necessary to provide and install the complete mechanical portion of this Contract, including HVAC systems as called for herein and on accompanying drawings. Parts of the mechanical division may be bid separately or in combination, at the Contractor's option; however, it shall be the responsibility of the General Contractor to assure himself that all items covered in the this Division have been included if he chooses to accept separate bids.

B. This Contractor shall refer to the Architectural and Structural drawings and install equipment, piping, etc. to meet building and space requirements. No equipment shall be bid on or submitted for approval if it will not fit in the space provided.

C. It is the intention of these Specifications that all mechanical systems shall be furnished complete with all necessary valves, controls, insulation, piping, devices, equipment, etc. necessary to provide a satisfactory installation in working order.

D. Contractor shall visit the site and acquaint himself thoroughly with all existing facilities and conditions that would affect his portion of the work. Failure to do so shall not relieve the Contractor from the responsibility of installing his work to meet the conditions.

E. This Contractor shall protect the entire system and all parts thereof from injury throughout the project and up to acceptance of the work. Failure to do so shall be sufficient cause for the Architect to reject any piece of equipment.

1.03 DEMOLITION

A. The contractor shall visit the site prior to bid to determine the extent of work required to complete the project.

B. Contractor shall coordinate demolition with owner. The Owner shall have “First Right of Refusal” regarding salvage of all equipment and materials to be removed. Locate equipment as directed by owner. All equipment and materials not salvaged by the owner shall be removed from the site and discarded at the contractor’s expense.

C. Contractor shall coordinate all work with general contractor and phase work as required by project.

D. All equipment piping, etc. required to be removed to accommodate the modifications shall be removed.

E. Contractor shall maintain services to existing facilities which shall remain during and after construction is complete.

F. Contractor shall coordinate any shutdown of services with the owner. It is intended that the building will remain occupied during construction. Contractor shall schedule shut down of services with the owner in order to prevent disruption of building occupancy.

G. Contractor shall be responsible for draining down of existing systems to complete demolition. All work shall be scheduled with the owner. Contractor shall also be responsible for refilling system and removing all air in order to return the systems to proper operating conditions.

H. All shut down of services shall be done at night or during a time period approved by the owner. The systems shall be required to be back up and running each morning unless otherwise approved by the owner.

1.04 GROUNDS AND CHASES

A. This Contractor shall see that all required chases, grounds, holes and accessories necessary for the installation of his work are properly built in as the work progresses; otherwise, he shall bear the cost of providing them.

1.05 CUTTING AND PATCHING

A. Initial cutting and patching shall be the responsibility of the General Contractor, with the Mechanical Contractor being responsible for laying out and marking any and all holes required for the reception of his work. No structural beams or joists shall be cut or thimbled without first receiving the approval of the Architect. After initial surfacing has been done, any further cutting, patching and painting shall be done at this Contractor's expense.

1.06 FILL AND CHARGES FOR EQUIPMENT

A. Fill and charge with materials or chemicals all those devices or equipment as required to comply with the manufacturer's guarantee or as required for proper operation of the equipment.

1.07 MACHINERY GUARDS

A. This Contractor shall provide v-belt guards for each v-belt drive or other hazardous drive. The guard shall enclose the drive entirely and shall have a hole for taking a tachometer reading.

B. Provide protective guard for belts, pulleys, gears, couplings, projecting set screws, keys and other rotating parts which are located such that a person might come in close proximity. Construct protective guard around angle iron frame, securely bolted to apparatus; comply with safety requirements. Install guard to completely enclose drives and pulleys and not interfere with lubrication of equipment. Provide 2 inch minimum diameter opening in fan belt guards housing for tachometer.

1.08 REPAIRING ROADWAYS AND WALKS

A. Where this Contractor cuts or breaks roadways or walks, in order to lay piping, he shall repair or replace these sections to meet the Architect's approval.

1.09 EXCAVATION AND BACKFILL

A. Contractor shall perform all excavating necessary to lay the specified services. Perform excavation of every description and of whatever substance encountered to depths indicated or specified. Pile materials suitable for backfilling a sufficient distance from banks of trenches to prevent slides or cave-ins. Comply with OSHA requirements for excavation, trenching and shoring. Waste excavation materials, rubbish, etc. shall be carted away from the premises, as indicated. Remove water from trenches by pumping or other approved method, discharge at a safe distance from the excavation.

B. Provide trenches of necessary width for proper laying of pipe and comply with latest publication of OSHA 2226 Excavating and Trenching Operations. Coordinate trench excavation with pipe installation to avoid open trenches for prolonged periods. Accurately grade bottoms of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil or the required thickness of bedding material at every point along its entire length.

C. Provide minimum 12 inches between outer surfaces and embankment or shoring, which may be used, when excavating for manholes and similar structures. Remove unstable soil that is incapable of supporting the structure in the bottom of the excavation to the depth necessary to obtain design bearing.

D. Material to be excavated is “unclassified”. No adjustment in the contract price will be made on account of the presence or absence of rock, shale, masonry, or other materials.

E. Protect existing utility lines that are indicated or the locations of which are made known prior to excavating and trenching and that are to be retained. Protect utility lines encountered during excavating and trenching operations, from damage during excavating, trenching and backfilling; if damaged, repair lines as directed by utilities, owner and A/E. Issue notices when utility lines that are to be removed are encountered within the area of operations in ample time for the necessary measures to be taken to prevent interruption of the service.

F. Provide trenches for utilities of a depth that will provide the following minimum depths of cover from existing grade or from indicated finished grades, or depths of cover in accordance with the manufacturer’s recommendations, whichever is lower:

    1. 3-Feet Minimum Cover: Chilled Water lines

G. Underground piping shall have a 6" bed of sand below the piping and backfilled with sand to 6" above the top of piping. Select fill may be used above the sand layer.

H. Backfill trenches after piping, fittings and joints have been tested and approved. Backfill trenches with sand to provide 6 inches of sand below piping and 12 inches of sand cover above piping.

I. Backfill remainder of trenches with satisfactory material consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones not over 1-1/2 inches in size. Deposit backfill material in 9 inch maximum layers, loose depth as indicated or as specified. Take care not to damage utility lines.

J. Deposit the remainder of backfill materials in the trench in 1 foot maximum layers and compact by mechanical means. Refer to architectural for minimum density for compaction (Minimum 85 percent of maximum soil density as determined by ASTM D 698). Re-open trenches and excavation pits improperly backfilled or where settlement occurs to the depth required to obtain the specified compaction, the refill and compact with the surface restored to the required grade and compaction.

K. Backfill utility line trench with backfill material, in 6 inch layers, where trenches cross streets, driveways, building slabs, or other pavement. Moisten each layer and compact to 95 percent of the maximum soil density as determined by ASTM D 698. Accomplish backfilling in such a manner as to permit the rolling and compaction of the filled trench with the adjoining material to provide the required bearing value so that paving of the area can proceed immediately after backfilling is complete.

1.10 WELDING

A. Weld piping and above grade steel tanks in accordance with qualified procedures using performance qualified welders and welding operators. Qualified procedures and welders in accordance with ASME Section IX. Welding procedures qualified by others and welders and welding operators qualified by another employer may be accepted as permitted by ANSI B31.1. Notify the A/E 24 hours in advance of tests, and perform the tests at the work site if practicable. Furnish A/E with a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. Apply welders or welding operators assigned symbols near each weld they make as permanent record.

1.11 NOISE AND VIBRATION

A. Provide the plumbing system and its associated components, items, piping, and equipment free of objectionable vibration or noise. Statically and dynamically balance rotating equipment and mount or fasten so that no vibration is transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional compensation.

1.12 PAINTING

A. All painting shall be by the General Contractor's Painting Sub-Contractor. All pipe, pipe covering, equipment, supports, hangers, etc. exposed in the building or equipment room shall be painted. This Contractor shall prepare the surface of the material to receive the first coat of paint.

B. All steel hydronic piping shall have two (2) coats of rust inhibitor primer applied prior to insulating.

C. All subsequent coatings shall be prepared by the Painting Sub-Contractor. Requirements covering paints, workmanship and preparation of surfaces as stated in the Architectural Specifications shall govern. Colors shall be approved by the Architect. All piping shall be color-coded.

D. All piping shall be color coded per the following:

1.	Chilled Water Piping	Blue
2.	Ductwork (Exposed in Building)	Black

1.13 CLEANING AND ADJUSTING

A. Upon completion of his work, the Contractor shall clean and adjust all equipment, controls, valves, etc.; clean all piping, ductwork, etc.; and leave the entire installation in good working order.

1.14 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Provide the Owner with three (3) copies of printed instructions indicating various pieces of equipment by name and model number, complete with parts lists, maintenance and repair instructions and test and balance report.

B. COPIES OF SHOP DRAWINGS WILL NOT BE ACCEPTABLE AS OPERATION AND MAINTENANCE INSTRUCTIONS BUT MUST BE INCLUDED IN SUBMITTAL PACKAGE.

C. This information shall be bound in plastic hardbound notebooks with the job name permanently embossed on the cover. Rigid board dividers with labeled tabs shall be provided for different pieces of equipment. Submit manuals to the Architect for approval.

D. In addition to the operation and maintenance brochure, the Contractor shall provide a separate brochure which shall include registered warranty certificates on all equipment, especially any pieces of equipment which carry warranties exceeding one (1) year.

E. The operation and maintenance brochure shall be furnished with a detailed list of all equipment furnished to the project, including the serial number and all pertinent nameplate data such as voltage, amperage draw, recommended fuse size, rpm, etc. The Contractor shall include this data on each piece of equipment furnished under this contract.

1.15 GUARANTEE

A. The Contractor shall guarantee all materials, equipment and workmanship for a period of one (1) year from the date of final acceptance of the project. This guarantee shall include furnishing of all labor and material necessary to make any repairs, adjustments or replacement of any equipment, parts, etc. necessary to restore the project to first class condition. This guarantee shall exclude only the changing or cleaning of filters. Warranties exceeding one (1) year are hereinafter specified with individual pieces of equipment.

1.16 LOCAL CONDITIONS

A. The location and elevation of all utility services is based on available surveys and utility maps and are reasonably accurate; however, these shall serve as a general guide only, and the Contractor shall visit the site and verify the location and elevation of all services to his satisfaction in order to determine the amount of work required for the execution of the Contract.

B. The Contractor shall contact the various utility companies, determine the extent of their requirements and he shall include in his bid all lawful fees and payments required by these companies for complete connection and services to the building, including meters, connection charges, street patching, extensions from meters to main, etc.

C. In case major changes are required, this fact, together with the reasons therefor, shall be submitted to the Architect, in writing, not less than seven (7) days before the date of bidding. Failure to comply with this requirement will make the Contractor liable for any changes, additions and expenses necessary for the successful completion of the project.

1.17 PERMITS, INSPECTIONS AND TESTS

A. All permits, fees, etc. for the installation, inspections, plan review, service connections locations, and/or construction of the work which are required by any authority and/or agencies having jurisdiction, shall be obtained and paid for by the Contractor. This shall be verified during the bidding process.

B. The Contractor shall make all tests required by the Architect, Engineer or other governing authorities at no additional cost to the Owner.

C. The Contractor shall notify the Architect and local governing authorities before any tests are made, and the tests are not to be drawn off a line covered or insulated until examined and approved by the authorities. In event defects are found, these shall be corrected and the work shall be retested.

D. Prior to requesting final inspection by the Architect, the Contractor shall have a complete coordination and adjustment meeting of all of his sub-contractors directly responsible for the operation of any portion of the system. At the time of this meeting, each and every sequence of operation shall be checked to assure proper operation. Notify the Architect in writing ten (10) days prior to this meeting, instructing him of the time, date and whom you are requesting to be present.

E. This project shall not be accepted until the above provisions are met to the satisfaction of the Architect.

1.18 CODES AND STANDARDS

A. The entire mechanical work shall comply with the rules and regulations of the City, Parish, County and State in which this project is being constructed, including the State Fire Marshal and the State Board of Health. All modifications required by these authorities shall be made without additional charge to the Owners. The Mechanical Contractor shall report these changes to the Architect and secure his approval before work is started.

B. In addition to the codes heretofore mentioned, all mechanical work and equipment shall conform to the applicable portions of the following specifications, codes and/or regulations:

1. American Society of Heating, Refrigeration and
2. Air Conditioning Engineers (ASHRAE)
3. National Electrical Code (NEC)
4. National Fire Protection Association (NFPA)
5. American Society of Mechanical Engineers (ASME)
6. American Gas Association (AGA)
7. International Building Code (IBC)
8. International Mechanical Code (IMC)
9. International Plumbing Code (IPC)
10. International Fuel Gas Code (IFGC)
11. Underwriters Laboratories (UL)
12. Life Safety Code (NFPA 101)
13. State Sanitary Code
14. Louisiana State Uniform Construction Code Council (LSUCCC)
15. Facility Guidelines Institute “Guidelines for Design and Construction of Hospitals and Outpatient Facilities” (2014 Edition)

C. All materials, equipment and accessories installed under this Contract shall conform to all

rules, codes, etc. as recommended by National Associations governing the manufacturer, rating and testing of such materials, equipment and accessories. All materials shall be new and of the best quality and first class in every respect. Whenever directed by the Architect, the Contractor shall submit a sample for approval before proceeding.

D. Where laws or local regulations provide that certain accessories such as gauges, thermometers, relief valves and parts be installed on equipment, it shall be understood that such equipment be furnished complete with the necessary accessories, whether or not called for in these Specifications.

E. All unfired pressure vessels shall be built in accordance with the A.S.M.E. Code and so stamped. Furnish shop certificates for each vessel.

1.19 REVIEW OF MATERIALS

A. Whenever manufacturers or trade names are mentioned in these Plans or Specifications, the words "or approved equivalent" shall be assumed to follow whether or not so stated. Manufacturers or trade names are used to establish a standard of quality only, and should not be construed to infer a preference. Equivalent products which meet the Architect's approval will be accepted; however, these products must be submitted to the Architect a minimum of seven (7) days prior to the Bid Date.

B. Submission shall include the manufacturer's name, model number, rating table and construction features.

C. Upon receipt and checking of this submittal, the Architect will issue an addendum listing items which are approved as equivalent to those specified. THE CONTRACTOR SHALL BASE HIS BID SOLELY ON THOSE ITEMS SPECIFIED OR INCLUDED IN THE "PRIOR APPROVAL ADDENDUM", AS NO OTHER ITEM WILL BE ACCEPTABLE.

D. Prior approval of a particular piece of equipment does not mean automatic final acceptance and will not relieve the Contractor of the responsibility of assuring himself that this equipment is in complete accord with the Plans and Specifications and that it will fit into the space provided. Shop drawings must be submitted on all items of equipment for approval as hereinafter specified.

E. Before proceeding with work and/or within thirty (30) days after the award of the General Contract for this work, the Mechanical Contractor shall furnish to the Architect complete shop and working drawings of such apparatus, equipment, controls, insulation, etc. to be provided in this project. These drawings shall give dimensions, weights, mounting data, performance curves and other pertinent information.

F. The Architect's approval of shop drawings shall not relieve the Contractor from the responsibility of incorrectly figured dimensions or any other errors which may be contained in these drawings. Any omission from the shop drawings or specifications, even though approved by the Architect, shall not relieve the Contractor from furnishing and erecting same.

G. If contractor submits hard copies, Six (6) sets of shop drawings shall be submitted to the Architect for approval. These submittals shall be supplied as part of this Contractor's contract.

H. This information shall be bound in plastic hardbound notebooks with the job name on the cover. Rigid board dividers with labeled tabs shall be provided for different pieces of materials and equipment. Submit shop drawings to the Architect for approval. Faxed copies shall not be acceptable. We prefer electronic submissions sent via E-Mail.

I. Required shop drawing submittals shall include but are not limited to the following:

1. Packaged Air Conditioning Equipment.
2. Grilles, registers, diffusers and louvers.
3. Ductwork and duct sealer.
4. Duct insulation and accessories.
5. Controls/Building Automation System.
6. Exhaust fans.
7. Unit heaters.
8. Double wall spiral pipe and fittings.
9. Variable air Volume Boxes / Terminal Units.
10. Pumps.
11. Chillers.
12. Relief and intake hoods.
13. Fire dampers
14. Smoke dampers.
15. Combination Fire and Smoke Dampers
16. Manual Dampers, Motorized Dampers and Control Dampers.
17. Actuators.
18. Test and Balancing Agency (including forms).

1.20 COORDINATION DRAWINGS

A. Submit three (3) black line prints of all mechanical room layouts showing locations of all equipment, piping, etc. to insure all will fit in space provided. Submit drawings at 1/4" scale. Layouts shall include equipment submitted on project to scale on plans.

B. Submit coordination drawings with the respective equipment shop drawings.

1.21 MINOR DEVIATIONS

A. Plans and detail sketches are submitted to limit, explain and define conditions, specified requirements, pipe sizes and manner of erecting work. Structural or other conditions may require certain modifications from the manner of installation shown, and such deviations are permissible and shall be made as required. However, specified sizes and requirements necessary for satisfactory operation shall remain unchanged. It may be necessary to shift ducts or pipes, or to change the shape of ducts, and these changes shall be made as required. All such changes shall be referred to the Architect and Engineer for approval before proceeding. Extra charges shall not be allowed for these changes. The contractor shall obtain a full set of plans and specifications for the coordination of his work prior to bidding this project. Items which are unclear to the bidding contractor shall be brought to the Architect and Engineers attention prior to bidding the project. An interpretation shall be clarified by the Architect and/or the Engineer prior to bidding.

B. The Contractor shall realize that the drawings could delve into every step, sequence or operation necessary for the completion of the project, without drawing on the Contractor's experience or ingenuity. However, only typical details are shown on the Plans. In cases where the Contractor is not certain about the method of installation of his work, he shall ask for details. Lack of details will not be an excuse for improper installation.

C. In general, the drawings are diagrammatic and the Contractor shall install his work in a manner so that interferences between the various trades are avoided. In cases where interferences do occur, the Architect is to state which item was first installed.

1.22 AS-BUILT RECORD DRAWINGS

A. The Contractor shall obtain at his cost, two sets of blackline prints of the original bid documents by the Architect. One set shall be kept on the site with all information as referenced below, and shall update same as the work progresses. The other set will be utilized to record all field changes to a permanent record copy for the Owner.

B. If the Contractor elects to vary from the Contract Documents and secures prior approval from the Architect for any phase of the work, he shall record in a neat and readable manner, ALL such variances on the blackline print in red. The original blackline prints shall be returned to the Architect for documentation.

C. All deviations from sizes, locations, and from all other features of the installations shown in the Contract Documents shall be recorded.

D. In addition, it shall be possible using these drawings to correctly and easily locate, identify and establish sizes of all piping, directions and the like, as well as other features of the work which will be concealed underground and/or in the finished building.

E. Locations of underground work shall be established by dimensions to columns, lines or walls, locating all turns, etc., and by properly referenced centerline or invert elevations and rates of fall.

F. For work concealed in the building, sufficient information shall be given so it can be located with reasonable accuracy and ease. In some cases this may be by dimension. In others, it may be sufficient to illustrate the work on the drawings in relation to the spaces in the building near which it was actually installed. The Architect's/Engineer's decision in this matter will be final.

G. The following requirements apply to all "As-Built" drawings:
   1. They shall be maintained at the Contractor’s expense.
   2. All such drawings shall be done carefully and neatly, and in a form approved by the Archtect/Engineer.
   3. Additional drawings shall be provided as necessary for clarifications.
   4. These drawings shall be kept up-to-date during the entire course of the work and shall be available upon request for examination by the Architect/Engineer; and when necessary, to establish clearances for other parts of the work.
   5. “As-built” drawings shall be returned to the Architect upon completion of the work and are subject to approval of the Architect/Engineer.

PART 2 PRODUCTS

2.01 HVAC SYSTEM PRODUCTS

A. Refer to individual Division 23 sections for mechanical products, controls, fans, pipe, tube and fitting materials and joining methods.

PART 3 EXECUTION

3.01 MANUFACTURER'S DIRECTION

A. The contractor shall install and operate all equipment and material in accordance with the manufacturer's installation and operating instructions. The manufacturer's instructions of installation and operation shall become part of the Contract Documents and shall supplement the Drawings and Specifications.

3.02 EQUIPMENT LABELS

A. Provide equipment labels for HVAC Equipment. Labels shall have permanent laminated construction secured to equipment.

B. Provide laminated plate for each V.A.V. box or constant volume box. Attach plate to ceiling grid to indicate location above ceiling. Coordinate color selection with owner.

3.03 PIPE LABELS

A. Provide pipe markers and directional arrows on all piping in mechanical equipment rooms, or which is exposed in building, and on both sides of all valves located above ceiling. Markers shall be as manufactured by W.H. Bradley Co., Marking Services Inc. or the equivalent. All letters shall be color-coded and sized as recommended by OSHA. Samples of the type of letters to be used shall be submitted with shop drawings. Piping shall be color-coded.

B. Pipe markers with arrows shall indicate lines content and shall be located 20 feet on center and at each change of direction of line. Identification bands shall be color coded to match pipe markers and shall be provided 10 feet on center. Pipe identification markers shall be taped at each end and shall be taped around the entire circumference of pipe.

C. The following Piping shall be identified:

1. Chilled Water Supply

2. Chilled Water Return

3.04 VALVE TAGS

A. Secure metal tags to all valves. Labeling on all valve tags shall include type of system the valve controls and the area of building, zone, or equipment number affected by valve operation. Tag shall be 2"minimum diameter brass, engraved with code number, service and size. A framed list of the valves, giving manufacturer's name, model number, type and location shall be mounted in the main equipment room.

3.05 ACCESS DOORS:

A. Provide access doors in walls, floors and ceilings to permit access to equipment and piping requiring service or adjustment.

1. Valves.

2. Manual balancing dampers and automatic control dampers.

3. Air terminal units and VRF indoor units.

4. Duct mounted filters and coils.

5. Drainage cleanouts.

6. Kitchen Hood exhaust ductwork in accordance with NFPA requirements.

7. Equipment shutoff protection devices such as disconnects, motor rated switches, etc.

8. Other mechanical equipment indicated in schedules or specifications which are requiring maintenance, adjustment or operation.

B. Provide hinged access doors and frames as follows:

1. Drywall Construction:

a. Provide with concealed spring hinges and flush screwdriver operated cam locks in sufficient number of the size of the panel.

b. Provide prime paintable surface (not galvanized).

c. Product: Milcor “Style M” (Karp DSC-214M).

2. Visible Masonry and Ceramic Tile:

a. Milcor “Style M” (Karp DSC-214M).

3. Cement Plaster:

a. Milcor “Style K” (KarpDSC-214 PL).

4. Acoustical Plaster:

a. Reinforced panel as required to prevent sagging. Provide continuous steel piano type hinge for the length of the panel, and sufficient number for the size of the panel. Provide factory prime paint surface (not galvanized).

b. Product: Milcor “Style AP” (Karp 214 PL).

5. Acoustical Tile:

a. Milcor “Style AT” (Larsen L-CPA).

C. Provide continuous concealed hinges and cam locks.

D. Provide UL listed 1-1/2 hour label “B” access doors with automatic self-closing latching mechanism where required.

E. Provide removable ceiling access tile section immediately adjacent to each mechanical or electrical device located in the ceiling plenum above removable tile ceiling.

F. Coordinate approval of type, color and location of access doors & frames with Architect.

3.06 CLEANING AND SERVICE

A. Upon Completion of this work, the contractor shall clean and adjust equipment, controls, valves, etc.;

B. Inspect, clean and service air filters and strainers immediately prior to final acceptance of project.

C. Provide complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced condition, check the charge and modify it for proper operation as required.

D. Place mechanical systems in complete working order. Clean equipment and piping materials thoroughly returning to “as new” condition prior to request for substantial completion.

E. Remove excess materials and debris from mechanical rooms and drain pans. Broom clean areas. Thoroughly clean ductwork inside and outside before air devices (diffusers, grilles, etc.) are installed.

3.07 TEMPORARY HEATING AND AIR CONDITIONING DURING CONSTRUCTION PHASE

A. Permanent building air conditioning equipment or systems are not designed to control building temperature and humidity levels during construction of the building. The building’s HVAC system is not designed nor is it well suited for the proper drying of building/construction materials, and should not be used for such purposes.

B. At all times, during construction phases, provide temporary ventilation both for comfort and protection of workers, for proper drying of wet work, and for proper curing of installed materials. Follow material manufacturer’s published instructions with regard to installation of building materials.

C. Provide temporary heat both for the comfort and protection of workers and as necessary to ensure suitable working conditions for construction operations of construction trades, and also as necessary for storage of products and materials. Refer to material manufacturer’s literature for environmental operational temperature and humidity requirements.

D. Provide temporary heat by use of self-contained, vented portable heating units, employing tanked gas or other approved heat source.

E. Use only heating apparatus and fuels labeled or listed by a “National Recognized Testing Laboratory” recognized by OSHA. Keep equipment and surroundings in clean, safe conditions.

F. Use flame resistant tarpaulins other material for temporary enclosures of space.

G. Provide temporary humidity control by the use of small incremental de-humidifiers, packaged desiccant type de-humidifiers, and/or packaged DX type air conditioners.

H. Do not permit space temperatures to reach or fall to a level which will cause damage to work. Coordinate the temperature and humidity requirements with the manufacturer of the finishes being provided.

I. Replace interior or exterior surfaces damaged by the use of temporary heaters with new materials or refinish at no additional expense to the owner.

J. As soon as practical after permanent heating, ventilation, and air conditioning systems are in place and operable, the contractor at his option, may provide heat from the permanent building heating system, until such time that the building is complete. It is recommended that the building's permanent heating and air conditioning systems not be utilized to maintain temperature and humidity conditions within the building during the construction phase. Small space heaters and portable de-humidifiers are suggested as sources of temperature and humidity control. It is the intent that the permanent HVAC systems should not be used to condition or control humidity during construction.

K. The use of permanent HVAC systems will require that the systems be complete and fully controllable by the Building Automation System (BAS) including the ability to remotely alarm proper maintenance personnel in the event of any and all system failure(s) or inability to maintain setpoint temperatures and humidity levels. Should the contractor elect to utilize the building's permanent HVAC system, the contractor shall bring the HVAC systems and ductwork back to an original unused condition or state by thoroughly cleaning and/or repairing both equipment and ductwork including repair and refinishing scrapes, tears, scratches and dents, cleaning ductwork, cleaning AHU coils, etc.

L. All dust, dirt, fungal growth, and debris in duct work shall be cleaned.

M. All disposable or wearable parts such as belts, filters, etc., shall be replaced without option or cause.

N. Contractor's Use of Permanent HVAC Systems:

1. Heating System:

a. Should the contractor (at his option and at his own risk), utilize the building's permanent heating systems provided under this contract to provide space heating prior to project completion date subject to the restraints stated herein.

b. The fuel for such space heating and for required tests of heating equipment shall be provided by contractor.

c. The start up of equipment for use by the contractor shall not commence any warranty period.

d. The heating system shall be operated only by qualified personnel, and shall be operated with all auxiliaries, safeties, and in accordance with manufacturer's instructions and good operating practice.

e. If at any time the Owner's Representative determines that the equipment is being improperly operated or maintained, contractor will be directed to disconnect its use.

f. Heating systems shall be operated and controlled to prevent temperature in any room or space in any building from exceeding 90 deg. F.

g. Temperature controls shall be functional to the extent that the operating temperatures of equipment, ductwork piping, etc., shall not either fall or be elevated above or below normal operating limits. The contractor shall demonstrate to the owner or his representative the ability of the system to be controlled, including limit alarms installed and the ability to monitor the systems off-site.

h. Systems shall not be operated unattended such as on holidays, weekends, nights, etc, nor shall personnel unfamiliar with the operation of the HVAC Systems be employed to “monitor or attend to” the systems such as security personnel, or janitorial staff. The heating system, when in operation, shall be continuously monitored by the mechanical contractor’s approved personnel.

i. Systems when activated, may be placed into operation without diffusers and registers in place, but filters capable of filtering gypsum dust or other associated construction dust and debris shall be provided both in air handling equipment and at return air grille locations. Filter all return air entering duct work, to prevent return air ductwork from accumulating dust or otherwise becoming dirty.

j. Prior to final acceptance of the work, the contractor shall place heating systems and related equipment in a condition equal to new in that contractor shall clean all ductwork, coils, equipment, etc.

k. All disposable or wearable parts such as belts, filters, etc., shall be replaced without option or cause.

2. Preliminary Heating Test, Adjusting and Balancing Report:

a. Provide a TAB report at the time the heating system(s) start-up which shall indicate the following conditions:

1) Air pressure drop across the unit filters
2) Air pressure drop across the unit’s cooling coil(s)
3) Air pressure drop across the unit’s heating coil(s)
4) Total static pressure produced by the unit
5) Discharge air static pressure
6) Fan RPM
7) Suction air pressure
8) Provide a unit pressure graph
9) Discharge air temperature (each air moving device)
10) Return air temperature (each air moving device)
11) Entering water temperatures (hot & chilled)
12) Leaving water temperatures (hot & chilled)
13) Water flow quantity (gpm) through the coil(s)(hot & chilled)

3. Air Conditioning System:

a. Should the contractor (at his option and at his own risk), utilize the building’s permanent air conditioning systems provided under this contract to provide space cooling and de-humidification prior to the project completion date. As such, any damages, loss of performance, wear, and other detrimental effects caused by the operational performance characteristics of the A/C system such as condensation, sweating of grilles, registers, diffusers, ducts, equipment, walls, floors, ceilings, and other conditions which may cause damage to building components or which cause mold, mildew, etc., shall be the total responsibility of the contractor.

b. The fuel, electricity or other energy required for space cooling and for any subsequent operation or testing shall be provided by the Contractor.

c. The cooling system(s) shall be operated only by fulling qualified personnel and shall be operated with all safety auxiliaries, and in accordance with manufacturer's instructions and good operating practice.

d. Start-up of equipment for use by the Contractor shall not commence any warranty period.

e. If at any time the Owner's Representative determines that the equipment is being improperly operated or maintained, the contractor will be directed to discontinue and disconnect its use and the contractor will be required to provide portable units to maintain space temperatures.

f. Temporary cooling and/or de-humidification systems shall be operated and controlled to prevent temperature and humidity in any room or space in any portion of the building from falling below 75 deg. F or above 65% relative humidity.

g. Temperature controls shall be functional to the extent that the operating temperatures of equipment, ductwork, piping, etc., shall not fall below the normal stated "design" operating limits. The contractor shall demonstrate to the owner or his representative the ability of the system to be controlled, including limit alarms installed and the ability to monitor the systems off-site.

h. Insulation systems for all piping, ductwork, etc., shall be completely installed prior to use of the permanent systems.

i. Systems shall not be operated unattended such as on holidays, weekends, nights, etc., nor shall personnel unfamiliar with the operation of the HVAC Systems be employed to "monitor or attend to" the systems such as security personnel, or janitorial staff. The air conditioning system when in operation, shall be continuously monitored by the mechanical contractor's approved personnel.

j. Systems when activated, may be placed into operation without diffusers and registers in place, but filters capable of filtering gypsum dust or other associated construction dust and debris shall be provided both in air handling equipment and at return air grille locations. Filter all return air entering duct work, to prevent return air duct work from accumulating dust or otherwise becoming dirty.

k. Contractor shall, prior to final acceptance of the work, place cooling systems and related equipment in a condition equal to new in that contractor shall clean all ductwork, coils, equipment, etc.

l. All disposable or wearable parts such as belts, filters, etc., shall be replaced without option or cause.

4. Preliminary Air Conditioning Test, Adjusting and Balancing Report:

a. Provide a TAB report at the time the heating system(s) start-up which shall indicate the following conditions:

1) Air pressure drop across the unit filters
2) Air pressure drop across the unit's cooling coil(s)

3) Air pressure drop across the unit's heating coil(s)
4) Total static pressure produced by the unit
5) Discharge air static pressure
6) Fan RPM
7) Suction air pressure
8) Provide a unit pressure graph
9) Discharge air temperature (each air moving device)
10) Return air temperature (each air moving device)
11) Entering water temperatures (hot & chilled)
12) Leaving water temperatures (hot & chilled)
13) Water flow quantity (gpm) through the coil(s)(hot & chilled)

END OF SECTION 23 00 00

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All materials and equipment shall be installed in accordance with Manufacturer's recommended installation methods for obtaining conformance with the Contract Documents.

B. Alignment of all motors, factory coupled or mounted, and all motors field coupled and mounted, shall be rechecked after all connections have been made and after 48 hours of operation in designed service.

C. Verify the voltage characteristics of each motor prior to ordering.

D. Verify the correct wire connections and rotation of equipment by "bumping" motor after wiring.

E. Confirm voltage imbalance on 3-phase motors is less than 2%.

3.2 APPLICATION: Except as specifically indicated, motors shall be selected as follows:

A. Phase:
   1. Less than 1.0 HP: Single-Phase.
   2. 1 HP and Larger: Three-phase.

B. Single Phase Starting:
   1. 1/8 HP and Less: Split phase or permanent split capacitor.
   2. Greater than 1/8 HP: Capacitor start.

C. Enclosure:
   1. Totally enclosed fan-cooled (TEFC) for all motors located outside above roof, in wet areas, in mechanical rooms, or elsewhere as indicated.
   2. Open drip-proof (ODP) for motors located elsewhere, in a clean, dry environment.

END OF SECTION 23 05 13

SECTION 23 05 16

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Flexible, ball-joint packed expansion joints.
2. Slip-joint, packed expansion joints.
3. Metal, compensator packless expansion joints.
4. Rubber union connector packless expansion joints.
5. Flexible-hose packless expansion joints.
6. Metal-bellows packless expansion joints.
7. Externally pressurized metal-bellows packless expansion joints.
8. Rubber packless expansion joints.
9. Grooved-joint expansion joints.
10. Alignment guides and anchors.
11. Pipe loops and swing connections.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKED EXPANSION JOINTS

A. Flexible, Ball-Joint Packed Expansion Joints FBJ-01:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Advanced Thermal Systems, Inc.
    b. Hyspan Precision Products, Inc.
    c. Mason Industries, Inc.

2. Standards: ASME Boiler and Pressure Vessel Code: Section II, "Materials"; ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.
3. Material: Carbon-steel assembly with asbestos-free composition packing.
4. Design: Provide 360-degree rotation and angular deflection.
5. Minimum Pressure Rating: 250 psig at 400 deg F (1725 kPa at 204 deg C).
6. Angular Deflection for NPS 6 (DN 150) and Smaller: 30 degree minimum.
7. Angular Deflection for NPS 8 (DN 200) and Larger: 15 degree minimum.
8. Seal Type: Two carbon steel and graphite seals suitable for continuous operation at temperature up to 650 deg F (343 deg C).
9. Internal Ball: Plated with minimum 1-mil chrome cover.
10. Ball Socket: One- or two-piece design with integral socket/retainer.

    a. Stuffing Box: Incorporates containment seals and compression seals for containment of injectable packing.
    b. Packing Cylinders: Provides packing under full line pressure with check valves to prevent blowback.

11. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

12. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

B. Slip-Joint Packed Expansion Joints SJ-01:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Adsco Manufacturing LLC.
   b. Advanced Thermal Systems, Inc.
   c. Hyspan Precision Products, Inc.
   d. Mason Industries, Inc.

2. Standard: ASTM F 1007.
3. Material: Carbon steel with asbestos-free PTFE packing.
4. Design: With internal guide and injection ports for repacking under full system pressure. Housing shall be furnished with drain ports and lifting ring. Include drip connection if used for steam piping.
5. Configuration: Single joint with base class(es), unless otherwise indicated.
6. Slip Tube for sizes NPS 1-1/2 (DN 40) through NPS 16 (DN 400): Schedule 80.
7. Slip Tube for sizes NPS 18 (DN 450) through NPS 24 (DN 600): Schedule 60.
8. Sliding Surface: 2 mil thick chrome finish.
9. End Connections: Flanged or welded ends to match piping system.

2.3 PACKLESS EXPANSION JOINTS

A. Metal, Compensator Packless Expansion Joints MCEJ-01:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Flex-Hose Co., Inc.
   b. Flexicraft Industries.
   c. Flex-Weld, Inc.
   d. Hyspan Precision Products, Inc.
   e. Mason Industries, Inc.
   f. Metraflex Company (The).

2. Minimum Pressure Rating: 200 psig (1380 kPa), unless otherwise indicated.
3. Description: Totally enclosed, externally pressurized, multi-ply bellows isolated from fluid flow by an internal pipe sleeve and external housing.
4. Joint Axial Movement: 2 inches (50 mm) of compression and 1/2 inch (12 mm) of extension.
5. Configuration for Copper Tubing: Multi-ply, phosphor-bronze bellows with copper pipe ends.

   a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint.
   b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Threaded.

6. Configuration for Steel Piping: Multi-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.

   a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
   b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged.

B. Rubber Union Connector Expansion Joints RUEJ-01:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Amber/Booth Company, Inc.; a VMC Group Company.
    b. Flex-Hose Co., Inc.
    c. Flexicraft Industries.
    d. General Rubber Corporation.
    e. Mason Industries, Inc.
    f. Proco Products, Inc.
    g. Unaflex.
    h. Unisource Manufacturing, Inc.

2. Material: Twin reinforced-rubber spheres with external restraining cables.
3. Minimum Pressure Rating: 150 psig at 170 deg F (1035 kPa at 77 deg C), unless otherwise indicated.
4. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

C. Flexible-Hose Packless Expansion Joints FHEJ-01:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Flex-Hose Co., Inc.
    b. Flexicraft Industries.
    c. Flex-Pression.
    d. Mason Industries, Inc.
    e. Metraflex Company (The).
    f. Unisource Manufacturing, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.

    a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 340 psig at 450 deg F (2340 kPa at 232 deg C) ratings.
    b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 500 psig at 450 deg F (3450 kPa at 232 deg C) ratings.

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F (2070 kPa at 21 deg C) and 225 psig at 450 deg F (1550 kPa at 232 deg C) ratings.
    b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F (2890 kPa at 21 deg C) and 315 psig at 450 deg F (2170 kPa at 232 deg C) ratings.

6. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Carbon-steel fittings with threaded end connections.

a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 325 psig at 600 deg F (2250 kPa at 315 deg C) ratings.
b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 515 psig at 600 deg F (3550 kPa at 315 deg C) ratings.

7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with flanged end connections.

a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F (1380 kPa at 21 deg C) and 145 psig at 600 deg F (1000 kPa at 315 deg C) ratings.
b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F (1900 kPa at 21 deg C) and 200 psig at 600 deg F (1380 kPa at 315 deg C) ratings.

8. Expansion Joints for Steel Piping NPS 8 to NPS 12 (DN 200 to DN 300): Carbon-steel fittings with flanged end connections.

a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F (860 kPa at 21 deg C) and 90 psig at 600 deg F (625 kPa at 315 deg C) ratings.
b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F (1130 kPa at 21 deg C) and 120 psig at 600 deg F (830 kPa at 315 deg C) ratings.

9. Expansion Joints for Steel Piping NPS 14 (DN 350) and Larger: Carbon-steel fittings with flanged end connections.

a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F (1130 kPa at 21 deg C) and 120 psig at 600 deg F (830 kPa at 315 deg C) ratings.

D. Metal-Bellows Packless Expansion Joints MBEJ-01:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adsco Manufacturing LLC.
b. Flex-Hose Co., Inc.
c. Flexicraft Industries.
d. Flo Fab Inc.
e. Mason Industries, Inc.
f. Metraflex Company (The).

2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
3. Type: Circular, corrugated bellows with external tie rods.
4. Minimum Pressure Rating: 200 psig (1379 kPa), unless otherwise indicated.
5. Configuration: Single joint with base class(es), unless otherwise indicated.
6. Expansion Joints for Copper Tubing: multi- ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint.

b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): threaded.
c. End Connections for Copper Tubing NPS 5 (DN 125) and Larger: Flanged.

7. Expansion Joints for Steel Piping: multi- ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.

a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
b. End Connections for Steel Pipe NPS 2-1/2 (DN 65) and Larger: Flanged.

E. Externally Pressurized Metal-Bellows Packless Expansion Joints EPEJ-01:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adsco Manufacturing LLC.
b. Flex-Hose Co., Inc.
c. Hyspan Precision Products, Inc.
d. Mason Industries, Inc.
e. Metraflex Company (The).
f. U.S. Bellows, Inc.

2. Minimum Pressure Rating: 200 psig (1379 kPa), unless otherwise indicated.
3. Description:

a. Totally enclosed, externally pressurized, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
b. Carbon-steel housing.
c. Drain plugs and lifting lug for the NPS 3 (DN 80) and larger.
d. Bellows shall have operating clearance between the internal pipe sleeves and the external shrouds.
e. Joints shall be supplied with a built-in scale to confirm the starting position and operating movement.
f. Joint Axial Movement: 6 inches (150 mm) 8 inches (200 mm) Insert compression limit of compression and 1 inch (25 mm) of extension.

4. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.
5. End Connection Configuration: Flanged; one raised, fixed and one floating flange.

F. Rubber Packless Expansion Joints REJ-01:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flexicraft Industries.
b. Flex-Weld, Inc.
c. Mason Industries, Inc.
d. Metraflex Company (The).

2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
3. Material: Fabric-reinforced rubber complying with FSA-PSJ-703.
4. Arch Type: multiple arches with external control rods.

5. Spherical Type: multiple spheres with external control rods.
6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1035 kPa) at 220 deg F (104 deg C).
7. Minimum Pressure Rating for NPS 5 and NPS 6 (DN 125 and DN 150): 140 psig (966 kPa) at 200 deg F (93 deg C).
8. Minimum Pressure Rating for NPS 8 to NPS 12 (DN 200 to DN 300): 140 psig (966 kPa) at 180 deg F (82 deg C).
9. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.4 GROOVED-JOINT EXPANSION JOINTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil International.
2. Grinnell G-Fire by Johnson Controls Company.
3. Shurjoint-Apollo Piping Products USA Inc.
4. Victaulic Company.

B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.

C. Standard: AWWA C606, for grooved joints.

D. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.

E. Couplings: Seven, flexible type for steel-pipe dimensions. Include ferrous housing sections, ethylene-propylene-diene terpolymer rubber gasket suitable for cold and hot water, and bolts and nuts.

2.5 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides AG-01:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flex-Hose Co., Inc.
b. Flexicraft Industries.
c. Flex-Weld, Inc.
d. Mason Industries, Inc.
e. Metraflex Company (The).

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.

4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Stud: Threaded, zinc-coated carbon steel.
    b. Expansion Plug: Zinc-coated steel.
    c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
    b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
    c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install packed-type expansion joints with packing suitable for fluid service.

C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

D. Install rubber packless expansion joints according to FSA-PSJ-703.

E. Install grooved-joint expansion joints to grooved-end steel piping.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 23 05 16

SECTION 23 05 17

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Jay R. Smith Mfg Co; a division of Morris Group International.
2. Zurn Industries, LLC.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. Airex Manufacturing.
3. CALPICO, Inc.
4. GPT; an EnPro Industries company.
5. Metraflex Company (The).
6. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

   a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves.
   b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.

2. Exterior Concrete Walls below Grade:

   a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system Galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

a. Piping Smaller Than NPS 6 (DN 150): PVC-pipe sleeves.
b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 23 05 17

SECTION 23 05 18

ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

2. Escutcheons for Existing Piping:

a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.
i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.
j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 23 05 18

SECTION 23 05 19

METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.

B. Related Sections:

1. Section 23 11 23 "Facility Natural-Gas Piping" for gas meters.
2. Section 23 22 16 "Steam and Condensate Piping Specialties" for steam and condensate meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Flo Fab Inc.
   b. Palmer Wahl Instrumentation Group.
   c. Trerice, H. O. Co.
   d. Weiss Instruments, Inc.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch (229-mm) nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.

   a. Design for Air-Duct Installation: With ventilated shroud.
   b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.

11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ashcroft Inc.
    b. Palmer Wahl Instrumentation Group.
    c. Trerice, H. O. Co.
    d. WATTS.
    e. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Liquid-filled Sealed type(s); cast aluminum or drawn steel; 6-inch (152-mm) nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Brass.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 (DN 8), ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 (DN 8) pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4 (DN 8), ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Nexus Valve, Inc.
2. Peterson Equipment Co., Inc.
3. Trerice, H. O. Co.
4. WATTS.
5. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 (DN 8), ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).

F. Core Inserts: EPDM self-sealing rubber.

2.7 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Nexus Valve, Inc.
2. Peterson Equipment Co., Inc.
3. Trerice, H. O. Co.
4. WATTS.

B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).

E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.8 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dwyer Instruments, Inc.
2. Pentair Valves & Controls; Penberthy Brand.
3. Rosemount Inc.; Emerson Electric Company.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 150 psig (1034 kPa).

E. Minimum Temperature Rating: 200 deg F (93 deg C).

F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gage for steam.

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flowmeter elements in accessible positions in piping systems.

P. Install wafer-orifice flowmeter elements between pipe flanges.

Q. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

R. Install permanent indicators on walls or brackets in accessible and readable positions.

S. Install connection fittings in accessible locations for attachment to portable indicators.

T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

U. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler.
3. Two inlets and two outlets of each chiller.
4. Inlet and outlet of each hydronic coil in air-handling units.
5. Two inlets and two outlets of each hydronic heat exchanger.
6. Inlet and outlet of each thermal-storage tank.
7. Outside-, return-, supply-, and mixed-air ducts.

V. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
3. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be the following:
1. Industrial-style, liquid-in-glass type.

B. Thermometers at inlet and outlet of each hydronic boiler shall be the following:
1. Industrial-style, liquid-in-glass type.

C. Thermometers at inlets and outlets of each chiller shall be the following:
1. Industrial-style, liquid-in-glass type.

D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:
1. Industrial-style, liquid-in-glass type.

E. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.

B. Scale Range for Condenser-Water Piping: 0 to 150 deg F and minus 20 to plus 70 deg C.

C. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F and 0 to 150 deg C.

D. Scale Range for Steam and Steam-Condensate Piping: 50 to 400 deg F and 0 to 200 deg C.

E. Scale Range for Air Ducts: Minus 40 to plus 110 deg F and minus 40 to plus 45 deg C.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each pressure-reducing valve shall be the following:

1. Liquid-filled, direct-mounted, metal case.

B. Pressure gages at inlet and outlet of each chiller chilled-water connection shall be the following:

1. Liquid-filled, direct-mounted, metal case.

C. Pressure gages at suction and discharge of each pump shall be[one of] the following:

1. Liquid-filled, direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 160 psi and 0 to 1100 kPa.

B. Scale Range for Condenser-Water Piping: 0 to 100 psi and 0 to 600 kPa.

C. Scale Range for Heating, Hot-Water Piping: 0 to 160 psi and 0 to 1100 kPa.

D. Scale Range for Steam Piping: 0 to 300 psi and 0 to 2500 kPa.

END OF SECTION 23 05 19

SECTION 23 05 23.12

BALL VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Steel ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.1 for power piping valves.
7. ASME B31.9 for building services piping valves.

C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

D. Refer to HVAC valve schedule articles for applications of valves.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 (DN 100) and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4 (DN 100).

H. Valves in Insulated Piping:

1. Include 2-inch (50-mm) stem extensions.
2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

I. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Two-Piece Brass Ball Valves with Full Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Apollo Flow Controls; Conbraco Industries, Inc.
c. Crane; a Crane brand.
d. KITZ Corporation.
e. NIBCO INC.

f. WATTS.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

2.3 BRONZE BALL VALVES

A. One-Piece Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. NIBCO INC.
c. WATTS.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

2.4 STEEL BALL VALVES

A. Class 150 Steel Ball Valves with Full Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. NIBCO INC.

2. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 285 psig (1964 kPa).
c. Body Design: Split body.

d. Body Material: Carbon steel, ASTM A 216, Type WCB.
e. Ends: Flanged.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.4 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller: One piece, regular port, brass or bronze with stainless-steel trim.

1. Valves may be provided with solder-joint ends instead of threaded ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger: Iron ball valves.

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Steel Ball Valves: Class 150.

C. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron ball valves.

a. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

2. Class 150 steel ball valves.

3.5 CONDENSER-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller: One piece, regular port, brass or bronze with stainless-steel trim.

1. Valves may be provided with solder-joint ends instead of threaded ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron ball valves.

a. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

2. Class 150 steel ball valves.

3.6 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller: One piece, regular port, brass or bronze with stainless-steel trim.

1. Valves may be provided with solder-joint ends instead of threaded ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron ball valves.

    a. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

2. Class 150 steel ball valves.

3.7 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG ([104 kPa]) OR LESS)

A. Pipe NPS 2 (DN 50) and Smaller: One piece, regular port, brass or bronze with stainless-steel trim.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron ball valves.

    a. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

2. Class 150 steel ball valves.

3.8 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG ([104 kPa]))

A. Pipe NPS 2 (DN 50) and Smaller: One piece, regular port, brass or bronze with stainless-steel trim.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron ball valves.

    a. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

2. Class 300 steel ball valves.

3.9 STEAM-CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller: One piece, regular port, brass or bronze with stainless-steel trim.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron ball valves.

    a. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

2. Class 300 steel ball valves.

END OF SECTION 23 05 23.12

SECTION 230523.13

BUTTERFLY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. High-performance butterfly valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:

   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B16.5 for pipe flanges and flanged fittings, NPS 1/2 through NPS 24.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B31.1 for power piping valves.
5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Actuator Types:

1. Gear Actuator: For valves NPS 8 (DN 200) and larger.
2. Handlever: For valves NPS 6 (DN 150) and smaller.
3. Chainwheel: Device for attachment to gear, stem, or other actuator of size and with chain for mounting height, according to "Valve Installation" Article.

G. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions with extended necks.

2.2 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Milwaukee Valve Company.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-68.
b. CWP Rating: 285 psig (1965 kPa) at 100 deg F (38 deg C).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
e. Seat: Reinforced PTFE or metal.
f. Stem: Stainless steel; offset from seat plane.
g. Disc: Carbon steel.
h. Service: Bidirectional.

B. Class 300, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Milwaukee Valve Company.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-68.
b. CWP Rating: 720 psig (4965 kPa) at 100 deg F (38 deg C).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: Carbon steel, cast iron, or ductile iron.
e. Seat: Reinforced PTFE or metal.
f. Stem: Stainless steel; offset from seat plane.
g. Disc: Carbon steel.
h. Service: Bidirectional.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine mating flange faces for damage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

D. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for butterfly valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.

F. Install valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 (DN 65) and Larger:
   1. High-Performance Butterfly Valves: Class 300, single flange.

3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 (DN 65) and Larger:
   1. High-Performance Butterfly Valves: Class 300, single flange.

END OF SECTION 23 05 23.13

SECTION 23 05 23.14

CHECK VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze lift check valves.
2. Iron swing check valves with closure control.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.1 for power piping valves.
6. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE LIFT CHECK VALVES

A. Class 125 Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane; a Crane brand.
b. Jenkins Valves; a Crane brand.
c. Stockham; a Crane brand.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.3 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. NIBCO INC.

b. Crane, A Crane Brand.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.
i. Closure Control: Factory-installed, exterior lever and spring.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements for valve tags and schedules in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Pump-Discharge Check Valves:

a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.
b. NPS 2-1/2 (DN 65) and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.

B. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125, lever and spring.

3.6 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125, lever and spring.

END OF SECTION 23 05 23.14

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
1.
2. Manufacturers:
a. Cooper B-Line, Inc.; a division of Cooper Industries.
b. Flex-Strut Inc.
c. Thomas & Betts Corporation, A Member of the ABB Group.
d. Unistrut; an Atkore International company.
e. Wesanco, Inc.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

B. Roof Sleepers for VRF outdoor condensing units: Pate Model ES-2 or equal, equipment rail supports, 18 ga. Galvanized steel, unitized construction with integral base plate, continuous welded corner seams, pressure treated wood nailer, counterflashing with screws. Height of support shall be a minimum of 16 inches. Coordinate layout of supports with the equipment manufacturer's representative and equipment point loading requirements. Coordinate flashing and exterior insulation with the roofing installer and Architect.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

E. Use thermal-hanger shield inserts for insulated piping and tubing.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
   11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
   12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
   13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
   15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION 23 05 29

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. Champion America.
d. Craftmark Pipe Markers.
e. Kolbi Pipe Marker Co.
f. LEM Products Inc.

g. Marking Services Inc.
h. Pipemarker.com; Brimar Industries, Inc.
i. Seton Identification Products; a Brady Corporation company.
j. emedco.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
7. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules).

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Champion America.
4. Craftmark Pipe Markers.
5. Kolbi Pipe Marker Co.
6. LEM Products Inc.
7. Marking Services Inc.
8. Pipemarker.com; Brimar Industries, Inc.
9. Seton Identification Products; a Brady Corporation company.
10. emedco.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm) and proportionately larger lettering for greater viewing distances.

2.3 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Champion America.
4. Craftmark Pipe Markers.
5. Kolbi Pipe Marker Co.
6. LEM Products Inc.
7. Marking Services Inc.
8. Pipemarker.com; Brimar Industries, Inc.
9. Seton Identification Products; a Brady Corporation company.
10. emedco.

B. Description: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or S-hook.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:

1. Chilled-Water Piping: White letters on a safety-green background.
2. Heating Water Piping: White letters on a safety-red background.
3. Refrigerant Piping: Black letters on a safety-orange background.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Chilled Water: 2 inches (50 mm), round.

b. Refrigerant: 1-1/2 inches (38 mm), round.
c. Hot Water: 2 inches (50 mm), round.
d. Gas: 2 inches (50 mm), round.

2. Valve-Tag Colors:

a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
b. Flammable Fluids: Black letters on a safety-yellow background.
c. Combustible Fluids: White letters on a safety-brown background.
d. Potable and Other Water: White letters on a safety-green background.
e. Compressed Air: White letters on a safety-blue background.
f. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

END OF SECTION 23 05 53

SECTION 23 05 66

ANTIMICROBIAL ULTRAVIOLET LAMP SYSTEMS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. UV-C lamp systems for large air-handling units.
2. UV-C lamp systems for packaged air-handling units.
3. Controls.

1.3 DEFINITIONS

A. UV-C: Ultraviolet-C short-wave spectrum.

B. UV-C Lamp System: Unit including ultraviolet lamp, power supply, housing, and supports.

C. UVGI: Ultraviolet germicidal irradiation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, include the following:

1. Product description with complete technical data, installation operation manual, performance data, and product specification sheets.
2. Operating characteristics; electrical characteristics; including electrical power requirements, total wattage and amperage.

B. Shop Drawings: For each UV-C lamp system.

1. Include plans, elevations, sections, mounting, and attachments to other work.
2. Include details of UV-C lamp system assemblies. Indicate dimensions, weights, required clearances, and components. Include diagrams for power, signal, and control wiring.
3. Include ultraviolet lamp watts for coil area in Watts (W) per sq. ft. (Watts (W) per sq. m).

C. Sustainable Design Submittals:

1. Product Data: For ultraviolet lamps, indicating mercury content and lamp life.

D. Product Schedule: For UV-C lamp systems. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Elevations and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members of equipment to which UV-C lamp systems will be attached.
2. Access points for service of ultraviolet lamps and power supplies.
3. Power connections.

B. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For UV-C lamp systems.

1. Provide installation, operation and maintenance manual(s).
2. Provide a list of all ultraviolet lamps and UV-C lamp system types used on Project.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 WARRANTY

A. Warranty: Manufacturer warrants products to be free from defects in material and workmanship under normal use of products. Manufacturer will repair or replace components of UV-C lamp systems that fail in materials or workmanship within specified warranty period subject to manufacturers published warranty.

B. Warranty Period for RLM Xtreme Power Supply: Five years from date of purchase. For all other components, one year from date of purchase.

C. Warranty Period X-Plus, UV-C Lamp System: Three years from date of purchase.

D. Warranty Period, All Ultraviolet Lamps: One year from date of installation provided lamps are installed within three months from date of purchase.

PART 2 - PRODUCTS

2.1 UV-C LAMP SYSTEMS FOR LARGE AIR-HANDLING UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide UV Resources; RLM Xtreme or comparable product by one of the following:

1. Dust Free, LP.
2. Atlantic Ultraviolet Corporation.

B. Description: UV-C lamp system consisting of power supply, power supply housing, wiring, ultraviolet lamp(s), lamp plug, lamp plug protector, encapsulated lamp, and lamp holder.

C. Power Supply: CSA and UL Listed, 120-277 Vac, 50/60 Hz, with a programmed rapid start.

1. Power Factor: High power factor, Class P, Sound Rated A, Type 1 Outdoor and with inherent thermal protection and without polychlorinated biphenyl.
2. Operating Temperature: From 34 deg F (1 deg C) to 194 deg F (90 deg C).
3. Wiring Harness: Plug-and-play.
4. Power Consumption: Maximum of 15 Watts (W) per sq. ft. (161.5 Watts (W) per sq. m).
5. Electrical Connection: Single electrical connection with service disconnect.

D. Ultraviolet Lamps: UV Resources EncapsuLamp Lamps, with lamp wattage and model number visibly printed on all lamps, less than 8 milligrams of mercury in each lamp. Ultraviolet lamps do not produce ozone.

1. Quantity and Type: Per schedule
2. Output: UV-C energy, primarily at the 253.7-nm wavelength with a 360-degree energy distribution.
3. Operating Temperature: From 34 deg F (1 deg C) to 158 deg F (70 deg C), 100-percent relative humidity, at any velocity.
4. Lamp Protection: Hermetically sealed with a thin layer of UV-C transmissible FEP to provide protection against lamp breakage, and to ensure lamp contents from a broken lamp are contained.
5. Lamp Life: Minimum of 9,000 hours with greater than 85 percent of initial output at end of lamp life.

E. Power Supply Housing: Galvanized steel 20 gauge (0.813 mm), powder coated finish, for installation inside or outside air-handling units or plenums. Capacity: 1 power supply per system.

1. Provide a suitable separate NEMA enclosure, for field installation of the power supply, on the exterior of an air-handling unit located outdoors.

F. Wiring Loom: UV-C resistant jacket materials with an internal aluminum/Mylar shield.

1. Conduit: UL recognized DXUZ2 flexible metal conduit (FMC). Entire loom covered with flexible galvanized steel.

G. Lamp Plug, Holder, and LampClamp: Four-pin type accommodates a single-ended high output (HO) lamp.

1. Lamp Plug and Holder Construction: UV resistant materials designed to connect the lamp to the plug.
2. UL Listing: Product is Listed and labeled to applicable UL Standards and requirements.
3. LampClamp Construction: UV resistant materials to ensure a water tight connection. A seal between the single ended ultraviolet lamp and the lamp plug prevents electrical shock, connection shorts, and lamp or power supply failure, from lamp pin oxidation or arcing.
4. Position: Adjustable positioning of lamp holder and LampClamp.

H. Lamp Holsters: Dual LampHolster is permanently affixed within the irradiated cavity to the interior surface of an air-handling unit, or to vertical supports.

1. Lamp Holster Construction: UV-C resistant materials for fastening strength.
2. Positioning: Flexible lamp positioning allows ease of lamp removal.

2.2 UV-C LAMP SYSTEM FOR PACKAGED AIR-HANDLING UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide UV Resources; X-Plus or comparable product by one of the following:

1. Dust Free, LP.
2. Atlantic Ultraviolet Corporation.

B. Description: UV-C lamp system consisting of a NEMA 4X (IP 66) power supply housing, four each, 1/2- or 3/4-inch (12.7- or 19-mm) electrical knock-outs, power supply with integrated lamp plug, lamp compression nut, and ultraviolet lamp.

C. Power Supply: UL Listed, 120-240 Vac, 50/60 Hz, with a programmed rapid start.

1. Power Factor: High power factor, Class P, Sound Rated A, Type 1 Outdoor and with inherent thermal protection and without polychlorinated biphenyl.
2. Output: Automatically sense and maximize lamp output, energy efficiency, and reliability for lamp lengths from 17 to 61 inches (432 to 1549 mm).
3. Operating Temperature: From 34 deg F (1 deg C) to 194 deg F (90 deg C).
4. Safety: Integral interlock switch on power supply.
5. Power Consumption: Maximum 15 Watts (W) per sq. ft. (161.5 Watts (W) per sq. m).
6. Electrical Connection: Single electrical connection[**with service disconnect**].

D. Ultraviolet Lamps: UV Resources EncapsuLamp Lamps with lamp wattage and model number visibly printed on all lamps, less than 8 milligrams of mercury in each lamp. Lamps do not produce ozone.

1. Quantity and Type: One T5, hot cathode, single-ended, 4-pin.
2. Output: UV-C energy, primarily at the 253.7-nm wavelength with a 360-degree energy distribution.
3. Base: Long-mount base type lamp. The lamp filament extends into the airstream beyond plenum walls and insulation.
4. Operating Temperature: From 34 deg F (1 deg C) to 158 deg F (70 deg C), 100-percent relative humidity, at any velocity.
5. Lamp Protection: Hermetically sealed with a thin layer of UV-C transmissible FEP to provide protection against lamp breakage, and to ensure lamp contents from a broken lamp are contained.
6. Lamp Life: Minimum of 9,000 hours with greater than 85 percent of initial output at end of lamp life.

E. Power Supply Housing: High performance, white polycarbonate for external thermal rejection, equipped with lamp support for lamp lengths up to 61 inches (1549 mm) and a weather tight cover with an integrated seal. Housing contains all components in one integral assembly for safety and serviceability without tools.

1. Interlock: Disrupt lever on the cover actuates the interlock switch to disconnect or restore power when removed or installed. Padlock eyelets lock the housing cover to guard against unwanted entry.
2. Surface Installation Mounting: Four mounting holes and gasket to seal housing to the mounting surface.

F. Lamp-Holder and LampClamp: Four-pin type accommodates a single-ended lamp.

1. Lamp-Holder Construction: UV resistant materials and designed to connect the lamp to the plug.

2. LampClamp Construction: UV resistant materials to ensure a water tight connection. A seal between the single ended ultraviolet lamp and the lamp plug prevents electrical shock, connection shorts, and lamp or power supply failure, from lamp pin oxidation or arcing.

2.3 CONTROLS

A. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC" for control equipment and in Section 230993.11 "Sequence of Operations for HVAC DDC."

B. Interface with DDC System for HVAC: Factory-installed hardware and software (where applicable) to enable the DDC system for HVAC to monitor, control, and display status and alarms.

C. Lamp and Power Supply Monitoring (for RLM Xtreme): Factory-assembled and tested, consisting of a housing, PC board, and wire block. Construction is designed to withstand installation inside air-handling unit airstream.

1. Housing: Industrial grade plastic equipped with a direct reading high output green LED, two mounting holes, and an external wiring block for wiring to a remote sensing or input device. PC board converts inductive field to a regulated electromotive force of 1- to 5-V dc, maximum.
2. Wiring Block: One positive and one negative terminal for No. 18 AWG and smaller wire.
3. Remote Monitor(s): Installed outside the plenum in a suitable NEMA enclosure to directly or remotely monitor the lamp and power supply combination, with the option for a single signal to the DDC system.

D. Operating Control: Monitor lamp and power supply combination and provide a single on/off signal to the facility DDC system. UV-C lamp system operates continuously. Interlock UV-C lamp system operation with air-handling unit and component access doors. When an access door is opened the UV-C lamp system is de-energized.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for UV-C lamp system to verify actual locations of ultraviolet lamps, and electrical connections before ultraviolet lamp system installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install UV-C lamp systems in accordance with manufacturer's installation manual and drawings, unless otherwise indicated.

B. Install ultraviolet lamps in each UV-C lamp system.

C. Supports for RLM Xtreme:

1. Size and rate supports for the UV-C lamp system weight.
2. Maintain the ultraviolet lamp position after cleaning and relamping.
3. Provide support for UV-C lamp system without causing deflection of air-handling unit casing.
4. Provide vertical supports on interior air-handling unit surfaces for UV-C lamp system.
5. UV-C lamp system mounting devices shall be capable of supporting a horizontal force of 100 percent of system weight, and a vertical force of 400 percent of system weight.
6. Equipment supports are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

D. Install UV-C lamp systems in locations that are accessible and that will permit servicing and maintenance.

E. Provide sufficient length of wiring loom to facilitate lamp connection to a remotely located power supply and/or power supply housing, such that the lamp and loom can be mounted anywhere in the system.

F. Seal air-handling unit penetrations to maintain integrity of air-handling unit casings.

G. Irradiation: Quantity of ultraviolet lamps are to be installed to provide an equal distribution of the available UV-C energy. When installed, the UV-C energy produced shall be of the lowest possible reflected and shadowed losses, distributed in a 360-degree pattern within the cavity or plenum space.

H. Intensity: UV-C lamp system modeling shall be included in the submittal and must contain the necessary calculations to demonstrate that a minimum of 6 lamp watts (RLM Xtreme) and 4 lamp watts (X-Plus) per each square foot of coil surface area to achieve a minimum of 100 microwatts per square centimeter equally distributed on the target surface as recommended by ASHRAE.

I. Housing Installation: The power supply housing can be installed inside or outside air-handling units or plenums.

J. Ultraviolet Lamp Installation: Mount ultraviolet lamp to irradiate surfaces, as well as the available line of sight airstream, through proper lamp placement, and incident angle reflection.

K. Safety: Comply with requirements in UL 1995, "Standard of Safety for Heating and Cooling Equipment", 5th edition. Provide mechanical interlock switch on access panels and doors to ultraviolet lamp systems, or within view of ultraviolet lamp systems, to insure that ultraviolet lamp systems will be de-energized when these accesses are opened. Warning signs and labels are specified in in Section 230553 "Identification for HVAC Piping and Equipment."

L. Signage: Comply with requirements in UL 1995 "Standard of Safety for Heating and Cooling Equipment", 5th edition. Mark access panels and doors to ultraviolet lamp systems with warning signs stating "WARNING: UV LIGHT SOURCE" and "DISCONNECT POWER BEFORE SERVICING". Warning signs and labels are specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 ELECTRIC CONNECTIONS

A. Comply with NFPA 70.

B. Provide electrical power and service disconnects to products requiring electrical connections.

C. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers" for service disconnects.

D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

E. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding connections.

3.4 IDENTIFICATION

A. Identify UV-C lamp systems with equipment labels. Comply with requirements for equipment labels specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing UV-C lamp systems, and after electrical circuitry has been energized, test units to confirm proper operation.

B. UV-C lamp system will be considered defective if it does not pass operation tests and inspections.

END OF SECTION 23 05 66

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK

A. The Contractor shall obtain the services of an independent Test and Balance (TAB) Company which specializes in the testing and balancing of heating, ventilating and air conditioning (HVAC) systems to test, adjust and balance all HVAC systems in the building(s).

B. The work included in this section consists of furnishing labor, instruments, and tools required in testing, adjusting and balancing the HVAC systems as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results. The testing, adjusting and balancing agency shall act as a reporting agency; that is, list and report each piece of equipment as to identification number, manufacturer, model number, serial number, proper location, specified performance, and report actual performance of all equipment as found during testing. The report is intended to be used during the life of the building as a ready reference indicating original conditions, equipment components, etc.

C. Representatives of the Test and Balance Company shall visit the job site during installation of the HVAC equipment, piping and ductwork as required.

D. Upon completion of the HVAC system installation, the Test and Balance Company shall perform all required testing and balancing with the full cooperation of the Contractor and his Sub-contractors. The Contractor shall make changes and/or adjustments to the HVAC system components that are required by the Test and Balance Company to accomplish proper balancing. The TAB agency shall not supply or install any materials or balancing devices such as pulleys, drives, belts, etc. All of this work is by the Contractor and shall be performed at no additional cost to the Owner.

E. The test and balance report complete with a summary page listing all deficiencies shall be submitted to the Architect for review. If the Architect agrees with the report, he shall sign it and return it to the Contractor. The test and balance report must be complete and must be accepted by the Architect prior to acceptance of the project. Any outstanding test and balance items shall be placed on the punch list and a monetary value shall be assigned to them.

F. After all deficiencies have been corrected the Architect shall sign the testing and balancing report, and the Test and Balance Company shall supply four (4) copies of the final and complete report to the Contractor for inclusion in the Operation and Maintenance Manuals.

G. The Test and Balance Company shall obtain a copy of all HVAC related shop drawings from the contractor. The contractor shall provide a set of approved shop drawings to the TAB contractor within 30 days from receiving approved shop drawings.

H. The items requiring testing, adjusting, and balancing include (but are not restricted to) the following:

1. Air Systems:

a. Supply Fan AHU
b. Supply Fan ERV
c. Relief Fans
d. Exhaust Fans
e. Zone Branch and main ducts
f. VAV Systems
g. Diffusers, Registers, Grilles and Dampers
h. Coils (Air Temperatures)
i. Valves
j. Vibration Isolators

2. Hydronic Systems:

a. Pumps
b. System Mains and Branches
c. Heat Exchangers
d. Coils

3. Duct leakage tests.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.4 INFORMATIONAL SUBMITTALS

A. Certified TAB reports.

B. Sample report forms.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC NEBB or TABB.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine operating safety interlocks and controls on HVAC equipment.

K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:
   1. Equipment and systems to be tested.
   2. Strategies and step-by-step procedures for balancing the systems.
   3. Instrumentation to be used.
   4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
   1. Airside:
      a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
      b. Duct systems are complete with terminals installed.
      c. Volume, smoke, and fire dampers are open and functional.
      d. Clean filters are installed.
      e. Fans are operating, free of vibration, and rotating in correct direction.
      f. Variable-frequency controllers' startup is complete and safeties are verified.
      g. Automatic temperature-control systems are operational.
      h. Ceilings are installed.
      i. Windows and doors are installed.
      j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
   2. After testing and balancing, install test ports and duct access doors.
   3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

K. Verify that air duct system is sealed as specified.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure total airflow.
      a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
      b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
      c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
      d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
   2. Measure fan static pressures as follows:
      a. Measure static pressure directly at the fan outlet or through the flexible connection.
      b. Measure static pressure directly at the fan inlet or through the flexible connection.
      c. Measure static pressure across each component that makes up the air-handling system.
      d. Report artificial loading of filters at the time static pressures are measured.
   3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
   4. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
   5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
   1. Measure airflow of submain and branch ducts.
   2. Adjust submain and branch duct volume dampers for specified airflow.
   3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.
   1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
   2. Measure inlets and outlets airflow.
   3. Adjust each inlet and outlet for specified airflow.
   4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.
   1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
   2. Re-measure and confirm that total airflow is within design.
   3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
   4. Mark all final settings.
   5. Test system in economizer mode. Verify proper operation and adjust if necessary.
   6. Measure and record all operating data.
   7. Record final fan-performance data.

3.6 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer's name, model number, and serial number.
   2. Motor horsepower rating.
   3. Motor rpm.
   4. Phase and hertz.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter size and thermal-protection-element rating.
   8. Service factor and frame size.

3.7 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.8 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

D. Ductwork that initially fails these tests shall be replaced, modified, resealed, etc. as required to meet the leakage requirement and then re-test to ensure compliance.

3.9 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Equipment with Fans: Plus or minus 10 percent.
   2. Exhaust Fans: Plus 10 percent.
   3. Outside Airflow: Plus 10 percent.
   4. Air Outlets and Inlets: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.
   3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:
   1. Fan curves.
   2. Manufacturers' test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB specialist.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   8. Report date.
   9. Signature of TAB supervisor who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
   11. Summary of contents including the following:
      a. Indicated versus final performance.
      b. Notable characteristics of systems.
      c. Description of system operation sequence if it varies from the Contract Documents.
   12. Nomenclature sheets for each item of equipment.
   13. Notes to explain why certain final data in the body of reports vary from indicated values.
   14. Test conditions for fans performance forms including the following:
      a. Settings for outdoor-, return-, and exhaust-air dampers.
      b. Conditions of filters.
      c. Cooling coil, wet- and dry-bulb conditions.
      d. Fan drive settings including settings and percentage of maximum pitch diameter.
      e. Settings for supply-air, static-pressure controller.
      f. Other system operating conditions that affect performance.

D. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.
2. Motor Data:
    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Filter static-pressure differential in inches wg.
    f. Preheat-coil static-pressure differential in inches wg.
    g. Cooling-coil static-pressure differential in inches wg.
    h. Heating-coil static-pressure differential in inches wg.
    i. Outdoor airflow in cfm.
    j. Return airflow in cfm.
    k. Outdoor-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

E. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and size.
    e. Manufacturer's serial number.
    f. Arrangement and class.
    g. Sheave make, size in inches, and bore.
    h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.

d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

F. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

G. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.11 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect.

B. Architect may randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:
1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, the design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply, return, exhaust and outdoor air.

2. Indoor, exposed supply, return, exhaust and outdoor air.

3. Tops of supply air diffusers, grilles and plenum boxes.

4. Mechanical Room Walls

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance, thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields as specified.

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Fire Rated Insulation:
   1. Manufacturer shall be one of the following:
      a. 3M FireMaster Fast Wrap 615+.
      b. Thermal Ceramics FireMaster.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
   1. Manufacturer shall be one of the following:
      a. Aeroflex, USA, Inc.
      b. Armacell LLC.

H. Fiber-Glass Blanket Insulation: Fiber-Glass bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Manufacturer shall be one of the following:

      a. Certainteed Corporation.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Knauf Insulation.
      d. Manson Insulation Inc.
      e. Owens Corning.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Manufacture shall be one of the following:
      a. Aeroflex USA, Inc.
      b. Armacell LLC.
      c. Foster Brand.

C. Fiber-Glass Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

   1. Manufacturer shall be one of the following:
      a. Childers Brand.
      b. Eagle Bridges – Marathon Industries.
      c. Foster Brand.
      d. Mon-Eco Industries, Inc.

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Manufacturer:
   a. Foster Brand.
   b. Knauf Insulation.
   c. Vimasco Corporation.
   d. Childers.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.7 SECUREMENTS

A. Bands:
1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
    d. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
    e. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
    f. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.8 WALL LINER

A. Fibrous-Glass Duct Liner (Medical grade): Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers shall be as follows:
    a. Certainteed
    b. Owens Corning
    c. Johns Manville
    d. Knauf

2. Maximum Thermal Conductivity:

    a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

    a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF FIBER-GLASS INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 WALL LINER

A. Apply on all mechanical room walls from floor to ceiling / deck.

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners or cut and fit to ensure butted-edge overlapping.
5. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

3.9 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies.

3.10 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer’s recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply air.

2. Indoor, concealed return air.

3. Indoor, concealed exhaust air.

4. Indoor, concealed outdoor air.

5. Indoor, return air plenum boxes.

6. Indoor, tops of ceiling diffusers and grilles.

7. Indoor, exposed supply air.

8. Indoor, exposed return air.

9. Indoor, exposed exhaust air.

10. Indoor, exposed outdoor air.

11. Mechanical Room Walls

B. Items Not Insulated:
1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.13 DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

B. Concealed, round and flat-oval, return-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

D. Concealed, round and flat-oval, exhaust-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

E. Concealed, rectangular, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

F. Concealed, rectangular, return-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

G. Concealed, rectangular, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

H. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:
   1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
   2. Minimum installed R-value shall be R-6.0.

I. Concealed, supply-air plenum insulation shall be the following:
   1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
   2. Minimum installed R-value shall be R-6.0.

J. Return air plenum boxes installation shall be the following:
   1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
   2. Minimum installed R-value shall be R-6.0.

K. Tops of supply air diffusers and grilles insulation shall be the following:
   1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
   2. Minimum installed R-value shall be R-6.0.

L. Exposed, rectangular, supply-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
   2. Minimum installed R-value shall be R-6.0.

M. Exposed, rectangular, return-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
   2. Minimum installed R-value shall be R-6.0.

N. Exposed, supply-air plenum insulation shall be the following:
   1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
   2. Minimum installed R-value shall be R-6.0.

O. Exposed, return-air plenum insulation shall be the following:
   1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
   2. Minimum installed R-value shall be R-6.0.

P. Mechanical Room Wall Liner
   1. Wall Liner: Fibrous glass, Type I, 2 inches thick.

END OF SECTION 23 07 13

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping, indoors.
2. Chilled-water and brine piping, indoors and outdoors.
3. Refrigerant suction and hot-gas piping, indoors and outdoors.

B. Related Sections:

1. Section 230713 "Duct Insulation."
2. Section 230716 "HVAC Equipment Insulation."
3. Section 232113.13 "Underground Hydronic Piping" for loose-fill pipe insulation in underground piping outside the building.
4. Section 336313 "Underground Steam and Condensate Distribution Piping" for loose-fill pipe insulation in underground piping outside the building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.

1. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
2. Sheet Form Insulation Materials: 12 inches (300 mm) square.

3. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).
4. Sheet Jacket Materials: 12 inches (300 mm) square.
5. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

    a. One 10-foot (3-m) section of NPS 2 (DN 50) straight pipe.
    b. One each of a 90-degree threaded, welded, and flanged elbow.
    c. One each of a threaded, welded, and flanged tee fitting.
    d. One NPS 2 (DN 50) or smaller valve, and one NPS 2-1/2 (DN 65) or larger valve.
    e. Four support hangers including hanger shield and insert.
    f. One threaded strainer and one flanged strainer with removable portion of insulation.
    g. One threaded reducer and one welded reducer.
    h. One pressure temperature tap.
    i. One mechanical coupling.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.

3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Owens Corning.
b. Knauf Insulation

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA.
b. Armacell LLC.
c. K-Flex USA.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation; Saint-Gobain North America.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Manson Insulation Inc.
e. Owens Corning.

I. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Manson Insulation Inc.
d. Owens Corning.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation; Saint-Gobain North America.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Manson Insulation Inc.
e. Owens Corning.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc
b. Rutland.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Ramco Insulation, Inc.
b. Rutland

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Ramco Insulation, Inc.
b. Rutland

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Aeroflex USA.
    b. Armacell LLC.
    c. K-Flex USA.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Mon-Eco Industries, Inc.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Mon-Eco Industries, Inc.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. The Dow Chemical Company.
    c. Voltek; a division of Sekisui America Corp.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Knauf Insulation.
    d. Mon-Eco Industries, Inc.
    e. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.

b. Foster Brand; H. B. Fuller Construction Products.
c. Mon-Eco Industries, Inc.
d. Owens Corning.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.

3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
6. Color: White or gray.
7. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
8. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.
c. Mon-Eco Industries, Inc.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

        1) ITW Insulation Systems; Illinois Tool Works, Inc.
        2) Johns Manville; a Berkshire Hathaway company.

6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

        1) ITW Insulation Systems; Illinois Tool Works, Inc.
        2) Johns Manville; a Berkshire Hathaway company.

7. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perms) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Airex Manufacturing.
    b. Johns Manville; a Berkshire Hathaway company.
    c. P.I.C. Plastics, Inc.
    d. Proto Corporation.
    e. Speedline Corporation.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. RPR Products, Inc.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper .
    d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
    e. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Avery Dennison Corporation, Specialty Tapes Division.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Avery Dennison Corporation, Specialty Tapes Division.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Avery Dennison Corporation, Specialty Tapes Division.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Johns Manville; a Berkshire Hathaway company.
b. ITW Insulation Systems; Illinois Tool Works, Inc.

2. Width: 3 inches (75 mm).
3. Film Thickness: 4 mils (0.10 mm).
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.9 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. RPR Products, Inc.

2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with closed seal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches (50 mm)] [4 inches (100 mm)] o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe

diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.10 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 3/4 inch (19 mm) thick.

B. Chilled Water and Brine, above 40 Deg F (5 Deg C):

1. NPS 12 (DN 300) and Smaller: Insulation shall be the following:

   a. Cellular Glass: 2 inches (50 mm) thick.

C. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch (25 mm) thick.

D. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: 1 inch (25 mm) thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Chilled Water and Brine:

1. All Pipe Sizes: Insulation shall be the following:

   a. Cellular Glass: 2 inches (50 mm) thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inches (25 mm) thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: 1 inches (25 mm) thick.

3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:
   1. PVC: 20 mils (0.5 mm) thick.

3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
   1. Aluminum, Smooth: 0.024 inch (0.61 mm) thick.

D. Piping, Exposed:
   1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch (0.61 mm) thick.

3.17 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 23 07 19

SECTION 23 09 23

DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. DDC system for monitoring and controlling of HVAC systems.
2. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for field installation.

B. Related Requirements:
1. Section 230923.17 "Level Instruments" for liquid-level switches, sensors, and transmitters that connect to DDC systems.
2. Section 230923.22 "Position Instruments" for limit switches that connect to DDC systems.
3. Section 230993 "Sequence of Operations for HVAC Controls" for control sequences in DDC systems.

1.3 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. BACnet Specific Definitions:

1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.
2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.

D. Binary: Two-state signal where a high signal level represents ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.

E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.

F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.

G. COV: Changes of value.

H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.

I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.

J. DOCSIS: Data-Over Cable Service Interface Specifications.

K. E/P: Voltage to pneumatic.

L. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.

M. HLC: Heavy load conditions.

N. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.

O. I/P: Current to pneumatic.

P. LAN: Local area network.

Q. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

R. Modbus TCP/IP: An open protocol for exchange of process data.

S. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.

T. MTBF: Mean time between failures.

U. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.

V. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.

W. PDA: Personal digital assistant.

X. Peer to Peer: Networking architecture that treats all network stations as equal partners.

Y. POT: Portable operator's terminal.

Z. PUE: Performance usage effectiveness.

AA. RAM: Random access memory.

BB. RF: Radio frequency.

CC. Router: Device connecting two or more networks at network layer.

DD. Server: Computer used to maintain system configuration, historical and programming database.

EE. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

FF. UPS: Uninterruptible power supply.

GG. USB: Universal Serial Bus.

HH. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.

II. VAV: Variable air volume.

JJ. WLED: White light emitting diode.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Multiple Submissions:

1. If multiple submissions are required to execute work within schedule, first submit a coordinated schedule clearly defining intent of multiple submissions. Include a proposed date of each submission with a detailed description of submittal content to be included in each submission.
2. Clearly identify each submittal requirement indicated and in which submission the information will be provided.
3. Include an updated schedule in each subsequent submission with changes highlighted to easily track the changes made to previous submitted schedule.

B. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation and maintenance instructions including factors effecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.

    a. Operator workstations.
    b. Servers.
    c. Printers.
    d. Gateways.
    e. Routers.
    f. Protocol analyzers.
    g. DDC controllers.
    h. Enclosures.
    i. Electrical power devices.
    j. UPS units.
    k. Accessories.
    l. Instruments.
    m. Control dampers and actuators.
    n. Control valves and actuators.

6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

C. Software Submittal:

1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.
3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
5. Listing and description of each engineering equation used with reference source.
6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
7. Description of operator interface to alphanumeric and graphic programming.
8. Description of each network communication protocol.
9. Description of system database, including all data included in database, database capacity and limitations to expand database.
10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden and system throughout.
11. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

D. Shop Drawings:

1. General Requirements:

    a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
    b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
    c. Prepare Drawings using CAD.
    d. Drawings Size: Same as project drawing scale.

2. Include plans, elevations, sections, and mounting details where applicable.
3. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Detail means of vibration isolation and show attachments to rotating equipment.
5. Plan Drawings indicating the following:

    a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
    b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
    c. Each desktop operator workstation, server, gateway, router, DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, if included in Project.
    d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
    e. Network communication cable and raceway routing.
    f. Information, drawn to scale, of project drawings.
    g. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.

6. Schematic drawings for each controlled HVAC system indicating the following:

    a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
    b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
    c. A graphic showing location of control I/O in proper relationship to HVAC system.
    d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
    e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
    f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
    g. Narrative sequence of operation.
    h. Graphic sequence of operation, showing all inputs and output logical blocks.

7. Control panel drawings indicating the following:

    a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
    b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
    c. Front, rear, and side elevations and nameplate legend.

d. Unique drawing for each panel.

8. DDC system network riser diagram indicating the following:

    a. Each device connected to network with unique identification for each.
    b. Interconnection of each different network in DDC system.
    c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or fiber-optic cable type. Indicate raceway type and size for each.
    d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.

9. DDC system electrical power riser diagram indicating the following:

    a. Each point of connection to field power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
    b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
    c. Each product requiring power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
    d. Power wiring type and size, race type, and size for each.

10. Monitoring and control signal diagrams indicating the following:

    a. Control signal cable and wiring between controllers and I/O.
    b. Point-to-point schematic wiring diagrams for each product.
    c. Control signal tubing to sensors, switches and transmitters.
    d. Process signal tubing to sensors, switches and transmitters.
    e. Pneumatic main air and control signal tubing to pneumatic damper and valve actuators, pilot-positioners if applicable, and associated transducers.

11. Color graphics indicating the following:

    a. Itemized list of color graphic displays to be provided.
    b. For each display screen to be provided, a true color copy showing layout of pictures, graphics and data displayed.
    c. Intended operator access between related hierarchical display screens.

E. System Description:

1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
3. System and product operation under each potential failure condition including, but not limited to, the following:

    a. Loss of power.
    b. Loss of network communication signal.
    c. Loss of controller signals to inputs and outpoints.
    d. Operator workstation failure.
    e. Server failure.
    f. Gateway failure.

g. Network failure
h. Controller failure.
i. Instrument failure.
j. Control damper and valve actuator failure.

4. Complete bibliography of documentation and media to be delivered to Owner.
5. Description of testing plans and procedures.
6. Description of Owner training.

F. Samples:

1. For each of the following exposed product, installed in finished space for approval of selection of aesthetic characteristics:

a. Gas instruments specified in Section 230923.16 "Gas Instruments."
b. Moisture instruments specified in Section 230923.19 "Moisture Instruments."
c. Motion instruments specified in Section 230923.21 "Motion Instruments."
d. Pressure instruments specified in Section 230923.23 "Pressure Instruments."
e. Temperature instruments specified in Section 230923.27 "Temperature Instruments."

G. Delegated-Design Submittal: For DDC system products and installation indicated as being delegated.

1. Supporting documentation showing DDC system design complies with performance requirements indicated, including calculations and other documentation necessary to prove compliance.
2. Schedule and design calculations for control dampers and actuators.

a. Flow at Project design and minimum flow conditions.
b. Face velocity at Project design and minimum airflow conditions.
c. Pressure drop across damper at Project design and minimum airflow conditions.
d. AMCA 500-D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
e. Maximum close-off pressure.
f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.
i. Actuator signal to control damper (on, close or modulate).
j. Actuator position on loss of power.
k. Actuator position on loss of control signal.

3. Schedule and design calculations for control valves and actuators.

a. Flow at Project design and minimum flow conditions.
b. Pressure-differential drop across valve at Project design flow condition.
c. Maximum system pressure-differential drop (pump close-off pressure) across valve at Project minimum flow condition.
d. Design and minimum control valve coefficient with corresponding valve position.
e. Maximum close-off pressure.
f. Leakage flow at maximum system pressure differential.
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.
i. Actuator signal to control damper (on, close or modulate).
j. Actuator position on loss of power.

k. Actuator position on loss of control signal.

4. Schedule and design calculations for selecting flow instruments.

a. Instrument flow range.
b. Project design and minimum flow conditions with corresponding accuracy, control signal to transmitter and output signal for remote control.
c. Extreme points of extended flow range with corresponding accuracy, control signal to transmitter and output signal for remote control.
d. Pressure-differential loss across instrument at Project design flow conditions.
e. Where flow sensors are mated with pressure transmitters, provide information for each instrument separately and as an operating pair.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

a. Product installation location shown in relationship to room, duct, pipe and equipment.
b. Structural members to which products will be attached.
c. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices and other installed devices.
d. Size and location of wall access panels for products installed behind walls and requiring access.

2. Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

a. Ceiling components.
b. Size and location of access panels for products installed above inaccessible ceiling assemblies and requiring access.
c. Items penetrating finished ceiling including the following:

1) Lighting fixtures.
2) Air outlets and inlets.
3) Speakers.
4) Sprinklers.
5) Access panels.
6) Motion sensors.
7) Pressure sensors.
8) Temperature sensors and other DDC control system instruments.

B. Qualification Data:

1. Systems Provider Qualification Data:

a. Resume of project manager assigned to Project.
b. Resumes of application engineering staff assigned to Project.
c. Resumes of installation and programming technicians assigned to Project.
d. Resumes of service technicians assigned to Project.

e. Brief description of past project including physical address, floor area, number of floors, building system cooling and heating capacity and building's primary function.
f. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
g. Names of staff assigned to past project that will also be assigned to execute work of this Project.
h. Owner contact information for past project including name, phone number, and e-mail address.
i. Contractor contact information for past project including name, phone number, and e-mail address.
j. Architect and Engineer contact information for past project including name, phone number, and e-mail address.

2. Manufacturer's qualification data.
3. Testing agency's qualifications data.

C. Welding certificates.

D. Product Certificates:

1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.
2. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with LonWorks.

E. Product Test Reports: For each product that requires testing to be performed by manufacturer and witnessed by a qualified testing agency.

F. Preconstruction Test Reports: For each separate test performed.

G. Source quality-control reports.

H. Field quality-control reports.

I. Sample Warranty: For manufacturer's warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
c. As-built versions of submittal Product Data.
d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.

e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
g. Engineering, installation, and maintenance manuals that explain how to:

1) Design and install new points, panels, and other hardware.
2) Perform preventive maintenance and calibration.
3) Debug hardware problems.
4) Repair or replace hardware.

h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
j. List of recommended spare parts with part numbers and suppliers.
k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
m. Licenses, guarantees, and warranty documents.
n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
o. Owner training materials.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Include product manufacturers' recommended parts lists for proper product operation over four-year period following warranty period. Parts list shall be indicated for each year.

C. Furnish parts, as indicated by manufacturer's recommended parts list, for product operation during two-year period following warranty period.

D. Furnish quantity indicated of matching product(s) in Project inventory for each unique size and type of following:

1. Network Controller: One.
2. Programmable Application Controller: One.
3. Application-Specific Controller: One.
4. Room Carbon Dioxide Sensor and Transmitter: One.
5. Room Moisture Sensor and Transmitter: One.
6. Room Pressure Sensor and Transmitter: One.
7. Room Temperature Sensor and Transmitter: One.
8. General-Purpose Relay: One.
9. Multifunction Time-Delay Relay: One.
10. Latching Relay: One.
11. Current-Sensing Relay: One.

12. Combination On-Off Status Sensor and On-Off Relay: One.
13. Transformer: One.
14. DC Power Supply: One.
15. Supply of 20 percent spare fiber-optic cable splice organizer cabinets for several re-terminations.

1.9 QUALITY ASSURANCE

A. DDC System Manufacturer Qualifications:

1. Nationally recognized manufacturer of DDC systems and products.
2. DDC systems with similar requirements to those indicated for a continuous period of 10 years within time of bid.
3. DDC systems and products that have been successfully tested and in use on at least five past projects.
4. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
5. Having full-time in-house employees for the following:

    a. Product research and development.
    b. Product and application engineering.
    c. Product manufacturing, testing and quality control.
    d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
    e. Owner operator training.

B. DDC System Provider Qualifications:

1. Authorized representative of, and trained by, DDC system manufacturer.
2. In-place facility located within 50 miles of Project.
3. Demonstrated past experience with installation of DDC system products being installed for period within five consecutive years before time of bid.
4. Demonstrated past experience on five projects of similar complexity, scope and value.
5. Each person assigned to Project shall have demonstrated past experience.
6. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
7. Service and maintenance staff assigned to support Project during warranty period.
8. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.
9. DDC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

C. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
4. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

E. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.

a. Install updates only after receiving Owner's written authorization.

3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.
4. Warranty Period: Two year(s) from date of Substantial Completion.

a. For Gateway: Three-year parts and labor warranty for each.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Siemens Open Protocol Native BACnet.

2.2 DDC SYSTEM DESCRIPTION

A. Microprocessor-based monitoring and control including analog/digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices to achieve a set of predefined conditions.

1. DDC system shall consist of a high-speed, peer-to-peer network of distributed DDC controllers, other network devices, operator interfaces, and software.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 WEB ACCESS

A. DDC system shall be Web compatible.

1. Web-Compatible Access to DDC System:

a. Operator workstation and server shall perform overall system supervision and configuration, graphical user interface, management report generation, and alarm annunciation.

b. DDC system shall support Web browser access to building data. Operator using a standard Web browser shall be able to access control graphics and change adjustable set points.
c. Web access shall be password protected.

2.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design DDC system to satisfy requirements indicated.

B. Delegated Design: Engage a qualified professional to design DDC system to satisfy requirements indicated.

1. System Performance Objectives:

a. DDC system shall manage HVAC systems.
b. DDC system control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.
c. DDC system shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.
d. DDC system shall operate while unattended by an operator and through operator interaction.
e. DDC system shall record trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.

C. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

D. DDC System Speed:

1. Response Time of Connected I/O:

a. AI point values connected to DDC system shall be updated at least every two seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
b. BI point values connected to DDC system shall be updated at least every two seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
c. AO points connected to DDC system shall begin to respond to controller output commands within two second(s). Global commands shall also comply with this requirement.
d. BO point values connected to DDC system shall respond to controller output commands within two second(s). Global commands shall also comply with this requirement.

2. Display of Connected I/O:

a. Analog point COV connected to DDC system shall be updated and displayed at least every five seconds for use by operator.

b. Binary point COV connected to DDC system shall be updated and displayed at least every five seconds for use by operator.
c. Alarms of analog and digital points connected to DDC system shall be displayed within 15 seconds of activation or change of state.
d. Graphic display refresh shall update within four seconds.
e. Point change of values and alarms displayed from workstation to workstation when multiple operators are viewing from multiple workstations shall not exceed graphic refresh rate indicated.

E. Network Bandwidth: Design each network of DDC system to include at least 30 percent available spare bandwidth with DDC system operating under normal and heavy load conditions indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.

F. DDC System Data Storage:

1. Include server(s) with disk drive data storage to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
2. When logged onto a server, operator shall be able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.
3. Server(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.
4. Server(s) shall use IT industry-standard database platforms such as Microsoft SQL Server and Microsoft Data Engine (MSDE).

G. Future Expandability:

1. DDC system size shall be expandable to an ultimate capacity of at least two times total I/O points indicated.
2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.
3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.

H. Input Point Displayed Accuracy: Input point displayed values shall meet following end-to-end overall system accuracy, including errors associated with meter, sensor, transmitter, lead wire or cable, and analog to digital conversion.

1. Energy:

a. Thermal: Within 3 percent of reading.
b. Electric Power: Within 1 percent of reading.
c. Requirements indicated on Drawings for meters not supplied by utility.

2. Flow:

a. Air: Within 2 percent of design flow rate.
b. Air (Terminal Units): Within 5 percent of design flow rate.
c. Water: Within 2 percent of design flow rate.
d. Steam: Within 5 percent of design flow rate.

3. Gas:

    a. Carbon Dioxide: Within 50 ppm.
    b. Carbon Monoxide: Within 5 percent of reading.
    c. Oxygen: Within 5 percent of reading.
    d. Refrigerant: Within 50 ppm.

4. Moisture (Relative Humidity):

    a. Air: Within 2 percent RH.
    b. Space: Within 2 percent RH.
    c. Outdoor: Within 2 percent RH.

5. Level: Within 2 percent of reading.
6. Pressure:

    a. Air, Ducts and Equipment: 0.5 percent of instrument range.
    b. Space: Within 0.5 percent of instrument range.
    c. Water: Within 0.5 percent of instrument range.
    d. Steam: Within 0.5 percent of instrument range.

7. Speed: Within 5 percent of reading.
8. Temperature, Dew Point:

    a. Air: Within 1 deg F (0.5 deg C).
    b. Space: Within 1 deg F (0.5 deg C).
    c. Outdoor: Within 3 deg F (1.5 deg C).

9. Temperature, Dry Bulb:

    a. Air: Within 1 deg F (0.5 deg C).
    b. Space: Within 1 deg F (0.5 deg C).
    c. Outdoor: Within 2 deg F (1 deg C).
    d. Chilled Water: Within 1 deg F (0.5 deg C).
    e. Condenser Water: Within 1 deg F (0.5 deg C).
    f. Heating Hot Water: Within 1 deg F (0.5 deg C).
    g. Energy Recovery Runaround Liquid: Within 1 deg F (0.5 deg C).
    h. Steam: Within 2 deg F (1 deg C).
    i. Temperature Difference: Within 0.25 deg F (0.15 deg C).
    j. Other Temperatures Not Indicated: Within 1 deg F (0.5 deg C).

10. Temperature, Wet Bulb:

    a. Air: Within 1 deg F (0.5 deg C).
    b. Space: Within 1 deg F (0.5 deg C).
    c. Outdoor: Within 2 deg F (1 deg C).

11. Vibration: Within 5 Insert number percent of reading.

I. Precision of I/O Reported Values: Values reported in database and displayed shall have following precision:

1. Current:

    a. Milliamperes: Nearest 1/100th of a milliampere.

b. Amperes: Nearest 1/10th of an ampere up to 100 A; nearest ampere for 100 A and more.

2. Energy:

a. Electric Power:

1) Rate (Watts): Nearest 1/10th of a watt through 1000 W.
2) Rate (Kilowatts): Nearest 1/10th of a kilowatt through 1000 kW; nearest kilowatt above 1000 kW.
3) Usage (Kilowatt-Hours): Nearest kilowatt through 10,000 kW; nearest 10 kW between 10,000 and 100,000 kW; nearest 100 kW for above 100,000 kW.

b. Thermal, Rate:

1) Heating: For Btu/h, nearest Btu/h up to 1000 Btu/h; nearest 10 Btu/h between 1000 and 10,000 Btu/h; nearest 100 Btu/h for above 10,000 Btu/h. For Mbh, round to nearest Mbh up to 1000 Mbh; nearest 10 Mbh between 1000 and 10,000 Mbh; nearest 100 Mbh above 10,000 Mbh (For watts, nearest watt up to 1000 W; for kilowatts, round to nearest kilowatt up to 1000 kW; nearest 10 kW between 1000 and 10,000 kW; nearest 100 kW for above 10,000 kW).
2) Cooling: For tons, nearest ton up to 1000 tons; nearest 10 tons between 1000 and 10,000 tons; nearest 100 tons above 10,000 tons (For watts, nearest watt up to 1000 W; for kilowatts, round to nearest kilowatt up to 1000 kW; nearest 10 kW between 1000 and 10,000 kW; nearest 100 kW for above 10,000 kW).

c. Thermal, Usage:

1) Heating: For Btu, nearest Btu up to 1000 Btu; nearest 10 Btu between 1000 and 10,000 Btu; nearest 100 Btu for above 10,000 Btu. For Mbtu, round to nearest Mbtu up to 1000 Mbtu; nearest 10 Mbtu between 1000 and 10,000 Mbtu; nearest 100 Mbtu above 10,000 Mbtu (For watt-hours, nearest watt-hour up to 1000 Wh; for kilowatt-hours, round to nearest kilowatt-hour up to 1000 kWh; nearest 10 kWh between 1000 and 10,000 kWh; nearest 100 kWh for above 10,000 kWh).
2) Cooling: For ton-hours, nearest ton-hours up to 1000 ton-hours; nearest 10 ton-hours between 1000 and 10,000 ton-hours; nearest 100 tons above 10,000 tons (For watt-hours, nearest watt-hour up to 1000 Wh; for kilowatt-hours, round to nearest kilowatt-hour up to 1000 kWh; nearest 10 kWh between 1000 and 10,000 kWh; nearest 100 kWh for above 10,000 kWh).

3. Flow:

a. Air: Nearest 1/10th of a cfm through 100 cfm; nearest cfm between 100 and 1000 cfm; nearest 10 cfm between 1000 and 10,000 cfm; nearest 100 cfm above 10,000 cfm (Nearest 1/10th of a L/s through 100 L/s; nearest L/s between 100 and 1000 L/s; nearest 10 L/s between 1000 and 10,000 L/s; nearest 100 L/s above 10,000 L/s).
b. Water: Nearest 1/10th gpm through 100 gpm; nearest gpm between 100 and 1000 gpm; nearest 10 gpm between 1000 and 10,000 gpm; nearest 100 gpm above 10,000 gpm (Nearest 1/10th of a L/s through 100 L/s; nearest L/s between 100 and 1000 L/s; nearest 10 L/s between 1000 and 10,000 L/s; nearest 100 L/s above 10,000 L/s).

c. Steam: Nearest 1/10th lb/hr through 100 lbs/hr; nearest lbs/hr between 100 and 1000 lbs/hr; nearest 10 lbs/hr above 1000 lbs/hr (Nearest 1/10th of a L/s through 100 L/s; nearest L/s between 100 and 1000 L/s; nearest 10 L/s between 1000 and 10,000 L/s; nearest 100 L/s above 10,000 L/s).

4. Gas:

   a. Carbon Dioxide (ppm): Nearest ppm.
   b. Carbon Monoxide (ppm): Nearest ppm.
   c. Oxygen (Percentage): Nearest 1/10th of 1 percent.
   d. Refrigerant (ppm): Nearest ppm.

5. Moisture (Relative Humidity):

   a. Relative Humidity (Percentage): Nearest 1 percent.

6. Level: Nearest 1/100th of an inch through 10 inches; nearest 1/10 of an inch between 10 and 100 inches; nearest inch above 100 inches (Nearest 1/100th of a mm through 10 mm; nearest 1/10th of a mm between 10 and 100 mm; nearest mm above 100 mm).
7. Speed:

   a. Rotation (rpm): Nearest 1 rpm.
   b. Velocity: Nearest 1/10th fpm through 100 fpm; nearest fpm between 100 and 1000 fpm; nearest 10 fpm above 1000 fpm (Nearest 1/100th of a M/s through 10 M/s; nearest 1/10th of a M/s above 10 M/s).

8. Position, Dampers and Valves (Percentage Open): Nearest 1 percent.
9. Pressure:

   a. Air, Ducts and Equipment: Nearest 1/10th in. w.c. (Nearest Pa up to 1000 Pa; nearest 10 Pa above 1000 Pa).
   b. Space: Nearest 1/100th in. w.c. (Nearest 1/10th Pa).
   c. Steam: Nearest 1/10th psig through 100 psig; nearest psig above 100 psig (Nearest kPa through 1000 kPa; nearest 10 kPa above 1000 kPa).
   d. Water: Nearest 1/10 psig through 100 psig; nearest psig above 100 psig (Nearest kPa through 1000 kPa; nearest 10 kPa above 1000 kPa).

10. Temperature:

    a. Air, Ducts and Equipment: Nearest 1/10th of a degree.
    b. Outdoor: Nearest degree.
    c. Space: Nearest 1/10th of a degree.
    d. Chilled Water: Nearest 1/10th of a degree.
    e. Condenser Water: Nearest 1/10th of a degree.
    f. Heating Hot Water: Nearest degree.
    g. Heat Recovery Runaround: Nearest 1/10th of a degree.
    h. Steam: Nearest degree.

11. Vibration: Nearest 1/10th in/s (Nearest 1/10th mm/s).
12. Voltage: Nearest 1/10 volt up to 100 V; nearest volt above 100 V.

J. Control Stability: Control variables indicated within the following limits:

1. Flow:

a. Air, Ducts and Equipment, except Terminal Units: Within 2 percent of design flow rate.
b. Air, Terminal Units: Within 5 percent of design flow rate.
c. Water: Within 2 Insert number percent of design flow rate.
d. Steam: Within 5 percent of design flow rate.

2. Gas:

a. Carbon Dioxide: Within 50 ppm.
b. Carbon Monoxide: Within 5 percent of reading.
c. Oxygen: Within 5 percent of reading.

3. Moisture (Relative Humidity):

a. Air: Within 2 percent RH.
b. Space: Within 2 percent RH.
c. Outdoor: Within 2 percent RH.

4. Level: Within 2 percent of reading.
5. Pressure:

a. Air, Ducts and Equipment: 0.5 percent of instrument range.
b. Space: Within 0.5 percent of instrument range.
c. Water: Within 0.5 percent of instrument range.
d. Steam: Within 0.5 percent of instrument range.

6. Temperature, Dew Point:

a. Air: Within 1 deg F (0.5 deg C).
b. Space: Within 1 deg F (0.5 deg C).

7. Temperature, Dry Bulb:

a. Air: Within 1 deg F (0.5 deg C).
b. Space: Within 1 deg F (0.5 deg C).
c. Chilled Water: Within 1 deg F (0.5 deg C).
d. Condenser Water: Within 1 deg F (0.5 deg C).
e. Heating Hot Water: Within 1 deg F (0.5 deg C).
f. Energy Recovery Runaround Liquid: Within 1 deg F (0.5 deg C).

8. Temperature, Wet Bulb:

a. Air: Within 1 deg F (0.5 deg C).
b. Space: Within 1 deg F (0.5 deg C).

K. Environmental Conditions for Controllers, Gateways, and Routers:

1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.

a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.

2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:

    a. Outdoors, Protected: Type 3.
    b. Outdoors, Unprotected: Type 4X.
    c. Indoors, Heated with Filtered Ventilation: Type 2.
    d. Indoors, Heated with Non-Filtered Ventilation: Type 12.
    e. Indoors, Heated and Air Conditioned: Type 1.
    f. Mechanical Equipment Rooms:

        1) Chiller and Boiler Rooms: Type 4.
        2) Air-Moving Equipment Rooms: Type 2.

    g. Localized Areas Exposed to Washdown: Type 4X.
    h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 3.
    i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4X.
    j. Hazardous Locations: Explosion-proof rating for condition.

L. Environmental Conditions for Instruments and Actuators:

1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

    a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated[**, cooled**] and ventilated as required by instrument and application.

2. Instruments, actuators and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments and actuators not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:

    a. Outdoors, Protected: Type 3.
    b. Outdoors, Unprotected: Type 4X.
    c. Indoors, Heated with Filtered Ventilation: Type 2.
    d. Indoors, Heated with Non-Filtered Ventilation: Type 12.
    e. Indoors, Heated and Air-conditioned: Type 1.
    f. Mechanical Equipment Rooms:

        1) Chiller and Boiler Rooms: Type 4.
        2) Air-Moving Equipment Rooms: Type 2.

    g. Localized Areas Exposed to Washdown: Type 4X.
    h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 3.

i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: [**4**] Type 4X.
j. Hazardous Locations: Explosion-proof rating for condition.

M. DDC System Reliability:

1. Design, install and configure DDC controllers, gateways and routers, to yield a MTBF of at least 40,000 hours, based on a confidence level of at least 90 percent. MTBF value shall include any failure for any reason to any part of products indicated.
2. If required to comply with MTBF indicated, include DDC system and product redundancy to maintain DCC system, and associated systems and equipment that are being controlled, operational and under automatic control.
3. Critical systems and equipment that require a higher degree of DDC system redundancy than MTBF indicated shall be indicated on Drawings.

N. Electric Power Quality:

1. Power-Line Surges:

a. ProtectDDC system products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41.
b. Do not use fuses for surge protection.
c. Test protection in the normal mode and in the common mode, using the following two waveforms:

1) 10-by-1000-mic.sec. waveform with a peak voltage of 1500 V and a peak current of 60 A.
2) 8-by-20-mic.sec. waveform with a peak voltage of 1000 V and a peak current of 500 A.

2. Power Conditioning:

a. ProtectDDC system products connected to ac power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be as follows:

1) At 85 percent load, output voltage shall not deviate by more than plus or minus 1 percent of nominal when input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
2) During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 percent of nominal.
3) Accomplish full correction of load switching disturbances within five cycles, and 95 percent correction within two cycles of onset of disturbance.
4) Total harmonic distortion shall not exceed 3-1/2 percent at full load.

3. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

O. Backup Power Source:

1. HVAC systems and equipment served by a backup power source shall have associated DDC system products that control such systems and equipment also served from a backup power source.

P. Continuity of Operation after Electric Power Interruption:

1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.5 PANEL-MOUNTED, MANUAL OVERRIDE SWITCHES

A. Manual Override of Control Dampers:

1. Include panel-mounted, two-position, selector switch for each automatic control damper being controlled by DDC controller.
2. Label each switch with damper designation served by switch.
3. Label switch positions to indicate either "Manual" or "Auto" control signal to damper.
4. With switch in "Auto" position signal to control damper actuator shall be control loop output signal from DDC controller.
5. With switch in "Manual" position, signal to damper actuator shall be controlled at panel with either an integral or separate switch to include local control.

    a. For Binary Control Dampers: Manual two-position switch shall have "Close" and "Open" switch positions indicated. With switch in "Close" position, damper shall close. With switch in "Open" position, damper shall open.
    b. For Analog Control Dampers: A gradual switch shall have "Close" and "Open" switch limits indicated. Operator shall be able to rotate switch knob to adjust damper to any position from close to open.

6. DDC controller shall monitor and report position of each manual override selector switch. With switch placed in "manual" position, DDC controller shall signal an override condition to alert operator that damper is under manual, not automatic, control.
7. Configure manual override switches to allow operator to manually operate damper while at panel without DDC controller installed and operational.
8. Terminal equipment including VAV units, do not require manual override unless otherwise indicated by sequence of operation.

B. Manual Override of Control Valves:

1. Include panel-mounted, two-position, selector switch for each automatic control valve being controlled by a DDC controller.
2. Label each switch with valve designation served by switch.
3. Label switch positions to indicate either "Manual" or "Auto" control signal to valve.
4. With switch in "Auto" position, signal to control-valve actuator shall be a control loop output signal from DDC controller.
5. With switch in "Manual" position, signal to valve actuator shall be controlled at panel with either an integral or a separate switch to include local control.

    a. For Binary Control Dampers: Manual two-position switch shall have "Close" and "Open" switch positions indicated. With switch in "Close" position, damper shall close. With switch in "Open" position, damper shall open.
    b. For Analog Control Dampers: A gradual switch shall have "Open" and "Close" switch limits indicated. Operator shall be able to rotate switch knob to adjust damper to any position from close to open.

6. DDC controller shall monitor and report position of each manual override selector switch. With switch placed in "manual" position, DDC controller shall signal an override condition to alert operator that valve is under manual, not automatic, control.
7. Configure manual override switches to allow operator to manually operate valve while at panel without DDC controller installed and operational.

2.6 SYSTEM ARCHITECTURE

A. System architecture shall consist of no more than three levels of LANs.

1. Level one LAN shall connect network controllers and operator workstations.
2. Level one LAN shall connect programmable application controllers to other programmable application controllers, and to network controllers.
3. Level two LAN shall connect application-specific controllers to programmable application controllers and network controllers.
4. Level two or Level three LAN shall connect application-specific controllers to application-specific controllers.

B. Minimum Data Transfer and Communication Speed:

1. LAN Connecting Operator Workstations and Network Controllers: 100 Mbps.
2. LAN Connecting Programmable Application Controllers: 1000 kbps.
3. LAN Connecting Application-Specific Controllers: 115,000 bps.

C. DDC system shall consist of dedicated LANs that are not shared with other building systems and tenant data and communication networks.

D. System architecture shall be modular and have inherent ability to expand to not less than two times system size indicated with no impact to performance indicated.

E. System architecture shall perform modifications without having to remove and replace existing network equipment.

F. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.

G. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.

H. Special Network Architecture Requirements:

1. Air-Handling Systems: For control applications of an air-handling system that consists of air-handling unit(s) and VAV terminal units, include a dedicated LAN of application-specific controllers serving VAV terminal units connected directly to controller that is controlling air-handling system air-handling unit(s). Basically, create a DDC system LAN that aligns with air-handling system being controlled.

2.7 DDC SYSTEM OPERATOR INTERFACES

A. Operator Means of System Access: Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:

1. Desktop and portable operator workstation with hardwired connection through LAN port.
2. Portable operator terminal with hardwired connection through LAN port.
3. Portable operator workstation with wireless connection through LAN router.
4. PDA with wireless connection through LAN router.
5. Remote connection using outside of system personal computer or PDA through Web access.
6. Remote connection using portable operator workstation and telephone dial-up modem.

B. Access to system, regardless of operator means used, shall be transparent to operator.

C. Network Ports: For hardwired connection of desktop or portable operator workstation. Network port shall be easily accessible, properly protected, clearly labeled, and installed at the following locations:

1. Each mechanical equipment room.
2. Each boiler room.
3. Each chiller room or outdoor chiller yard.
4. Each cooling tower location.
5. Each different roof level with roof-mounted air-handling units or rooftop units.
6. Security system command center.
7. Fire-alarm system command center.

D. Desktop Workstations:

1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.
3. Able to communicate, with modems, remotely with any device connected to any DDC system LAN.
4. Communication via a modem shall not interfere with LAN activity and LAN activity shall not prevent workstation from handling incoming calls.

E. Portable Workstations:

1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.
3. Connect to DDC system Level two LAN through a communications port on an application-specific controller, or a room temperature sensor connected to an application-specific controller.
4. Connect to system through a wireless router connected to Level one LAN.
5. Portable workstation shall be able to communicate with any device connected to any system LAN regardless of point of physical connection to system.
6. Monitor, program, schedule, adjust set points, and report capabilities of I/O connected anywhere in system.
7. Have dynamic graphic displays that are identical to desktop workstations.

F. POT:

1. Connect DDC controller through a communications port local to controller.
2. Able to communicate with any DDC system controller that is directly connected or with LAN or connected to DDC system.

G. Personal Digital Assistant:

1. Connect to system through a wireless router connected to LAN.
2. Able to communicate with any DDC controller connected to DDC system.

H. Telephone Communications:

1. Through use of a standard modem, operator shall be able to communicate with any device connected to any system LAN.
2. Have auto-dial and auto-answer communications to allow desktop and portable workstations and DDC controllers to communicate with remote workstations and remote DDC controllers via telephone lines.

a. Desktop and Portable Operator Workstation Computers with Modems:

1) Operators shall be able to perform all control functions, report functions, and database generation and modification functions as if directly connected to system LAN.
2) Have routines to automatically answer calls, and either file or display information sent remotely.
3) Communications taking place over telephone lines shall be completely transparent to operator.
4) Dial-up program shall maintain a user-definable cross-reference and associated telephone numbers so it is not required to remember or manually dial telephone numbers.

b. DDC Controllers:

1) Not have modems unless specifically indicated for a unique controller.
2) Controllers with modems shall automatically place calls to report critical alarms, or to upload trend and historical information for archiving.
3) Analyze and prioritize alarms to minimize initiation of calls.
4) Buffer noncritical alarms in memory and report them as a group of alarms, or until an operator manually requests an upload.
5) Make provisions for handling busy signals, no-answers, and incomplete data transfers.
6) Call default devices when communications cannot be established with primary devices.

I. Critical Alarm Reporting:

1. Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention.
2. DDC system shall send alarm notification to multiple recipients that are assigned for each alarm.
3. DDC system shall notify recipients by any or all means, including e-mail, text message and prerecorded phone message to mobile and landline phone numbers.

J. Simultaneous Operator Use: Capable of accommodating up to five simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

2.8 NETWORKS

A. Acceptable networks for connecting operator workstations and network controllers include the following:

1. ATA 878.1, ARCNET.
2. CEA-709.1-C.
3. IP.
4. IEEE 8802-3, Ethernet.

B. Acceptable networks for connecting programmable application controllers include the following:

1. ATA 878.1, ARCNET.
2. CEA-709.1-C.
3. IP.
4. IEEE 8802-3, Ethernet.

C. Acceptable networks for connecting application-specific controllers include the following:

1. ATA 878.1, ARCNET.
2. CEA-709.1-C.
3. EIA-485A.
4. IP.
5. IEEE 8802-3, Ethernet.

2.9 NETWORK COMMUNICATION PROTCOL

A. Network communication protocol(s) used throughout entire DDC system shall be open to public and available to other companies for use in making future modifications to DDC system.

B. ASHRAE 135 Protocol:

1. ASHRAE 135 communication protocol shall be sole and native protocol used throughout entire DDC system.
2. DDC system shall not require use of gateways except to integrate HVAC equipment and other building systems and equipment, not required to use ASHRAE 135 communication protocol.
3. If used, gateways shall connect to DDC system using ASHRAE 135 communication protocol and Project object properties and read/write services indicated by interoperability schedule.
4. Operator workstations, controllers and other network devices shall be tested and listed by BACnet Testing Laboratories.

C. CEA-709.1-C Protocol:

1. DDC system shall be an open implementation of LonWorks technology using CEA 709.1-C communication protocol and using LonMark SNVTs as defined in LonMark SNVT list exclusively for communication throughout DDC system.
2. LNS shall be used for all network management including addressing and binding of network variables.

    a. Final LNS database shall be submitted with Project closeout submittals.
    b. All devices shall be online and commissioned into LNS database.

3. All devices connected to DDC system network(s) shall use CEA-709.1-C protocol and be installed so SCPT output from any node on network can be bound to any other node in the domain.

D. Industry Standard Protocols:

1. DDC system shall use any one or a combination of the following industry standard protocols for network communication while complying with other DDC system requirements indicated:

    a. ASHRAE 135.
    b. CEA-709.1-C.
    c. Modbus Application Protocol Specification V1.1b.

2. Operator workstations and network controllers shall communicate through ASHRAE 135 protocol.
3. Portions of DDC system networks using ASHRAE 135 communication protocol shall be an open implementation of network devices complying with ASHRAE 135. Network devices shall be tested and listed by BACnet Testing Laboratories.
4. Portions of DDC system networks using CEA-709.1-C communication protocol shall be an open implementation of LonWorks technology using CEA-709.1-C communication protocol and using LonMark SNVTs as defined in LonMark SNVT list exclusively for DDC system.
5. Portions of DDC system networks using Modbus Application Protocol Specification V1.1b communication protocol shall be an open implementation of network devices and technology complying with Modbus Application Protocol Specification V1.1b.
6. Gateways shall be used to connect networks and network devices using different protocols.

2.10 DESKTOP OPERATOR WORKSTATIONS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    1. Dell Inc.

B. Performance Requirements:

    1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
    2. Energy Star compliant.

C. Personal Computer:

    1. Minimum Processor Speed: <**Insert gigahertz**>.
    2. RAM:

        a. Capacity: [**24**] [**48**] <**Insert value**> [**GB**] [**TB**].
        b. Speed and Type: [**1333**] <**Insert value**> MHz, <**Insert type**>.
        c. Expandable Capacity: [**24**] [**72**] <**Insert value**> [**GB**] [**TB**].

    3. Hard Drive:

        a. Number of Hard Drives: [**One**] [**Two**] <**Insert number**>.
        b. Capacity: <**Insert number and measurement unit**>.
        c. Minimum Average Seek Time: <**Insert number and measurement unit**>.
        d. Cache Buffer Size: <**Insert number and measurement unit**>.
        e. <**Insert requirements**>.

    4. Second Hard Drive:

a. Capacity: <**Insert number and measurement unit**>.
b. Minimum Average Seek Time: <**Insert number and measurement unit**>.
c. Cache Buffer Size: <**Insert number and measurement unit**>.
d. <**Insert requirements**>.

5. Optical Drive:

a. Type: <**Insert type**>.
b. Minimum Average Access Time: <**Insert number**> ms.
c. Data Transfer Speed: <**Insert number**> [**MB**] [**TB**]/s.
d. Reading Formats: Data, audio, recordable, <**Insert other**> and rewritable.

6. Optical Read and Write Drive:

a. Include with at least 2 MB of data buffer.
b. Type: <**Insert type**>.
c. Minimum Data Buffer Capacity: <**Insert number and measurement unit**>.
d. Minimum Average Access Time: <**Insert number**> ms.
e. Nominal Data Transfer Rates:

1) Reading: <**Insert number**> [**MB**] [**TB**]/s.
2) Writing: <**Insert number**> [**MB**] [**TB**]/s.

f. Average access time of 150 ms or less.
g. MTBF of at least 100,000 power-on hours.

7. At least four expansion slots of [**32**] [**64**] <**Insert number**> bit.

8. Video Card:

a. Resolution: [**1920 by 1200**] <**Insert values**> pixels.
b. RAM: <**Insert number**> [**MB**] [**GB**] [**TB**].
c. Controller Speed: <**Insert number**> [**MHz**] [**GHz**].
d. On-Board Memory Speed: <**Insert number**> [**MHz**] [**GHz**].
e. On-Board Memory Data Width: <**Insert number**> bit.

9. Sound Card:

a. At least 128 voice wavetable synthesis.
b. Capable of delivering three-dimensional sound effects.
c. High-resolution 16-bit stereo digital audio recording and playback with user-selectable sample rates up to 48,000 Hz.

10. Network Interface Card: Include card with connection, as applicable.

a. 10-100-1000 base TX Ethernet with RJ45 connector port.
b. 100 base FX Ethernet with SC or ST port.

11. Cable Modem:

a. <**Insert number**> Mbps.
b. Certified to comply with DOCSIS Cable Modem to Customer Premise Equipment Interface Specification, Version 3.0 and backward compatible with earlier versions.
c. [**Ethernet**] [**or**] [**USB**] connectivity.

12. Optical Modem: Full duplex link for connection to fiber-optic cable provided.

13. I/O Ports:

    a. Two second-generation USB 2.0 ports on front panel, six on back panel, and three internal on motherboard.
    b. One serial port.
    c. One parallel port.
    d. Two PS/2 ports.
    e. One RJ-45.
    f. One stereo line-in and headphone line-out on back panel.
    g. One microphone and headphone connector on front panel.
    h. One IEEE 1394 on front and back panel with PCI-e card.
    i. One ESATA port on back panel.

14. Battery: Life of at least three years to maintain system clock/calendar and ROM, as a minimum.

D. Keyboard:

1. 101 enhanced keyboard.
2. Full upper- and lowercase ASCII keyset, numeric keypad, dedicated cursor control keypad, and 12 programmable function keys.
3. Wireless operation within up to 72 inches (1800 mm) in front of workstation.

E. Pointing Device:

1. Either a two- or three-button mouse.
2. Wireless operation within up to 72 inches (1800 mm) in front of workstation.

F. Flat Panel Display Monitor:

1. Display:

    a. Color display with <**Insert inches (mm)**> diagonal viewable area.
    b. [**Digital**] [**or**] [**analog**] input signal.
    c. Aspect Ratio: [**16 to 9**] <**Insert value**>.
    d. Antiglare display.
    e. Response Time: <**Insert number**> ms.
    f. Dynamic Contrast Ratio: [**50000 to 1**] <**Insert ratio**>.
    g. Brightness: [**250 cd/sq. m**] <**Insert value**>.
    h. Tilt adjustable base.
    i. Energy Star compliant.
    j. Resolution: [**1920 by 1080**] <**Insert value**> pixels at 60 Hz with pixel size of [**0.277**] <**Insert number**> mm or smaller.
    k. Number of Displays: [**One**] [**Two**] <**Insert number**>.

G. Speakers:

1. Two, with individual controls for volume, bass and treble.
2. Signal to Noise Ratio: At least 65 dB.
3. Power: At least 4 W per speaker/channel.
4. Magnetic shielding to prevent distortion on the video monitor.

H. I/O Cabling: Include applicable cabling to connect I/O devices.

2.11 PORTABLE OPERATOR WORKSTATIONS

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Performance Requirements:

1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
2. Energy Star compliant.
3. Hardware and software shall support local down-loading to DDC controllers.
4. Data transfer rate to DDC controller shall be at network speed.

C. Processor:

1. Minimum Processor Speed: <**Insert gigahertz**>.
2. RAM:

   a. Capacity: <**Insert value**> [**GB**] [**TB**].
   b. Speed and Type: <**Insert value**> MHz, <**Insert type**>.
   c. Expandable Capacity: <**Insert value**> [**GB**] [**TB**].

3. Hard Drive:

   a. Number of Hard Drives: [**One**] [**Two**] <**Insert number**>.
   b. Capacity: <**Insert number and measurement unit**>.
   c. Minimum Average Seek Time: <**Insert number and measurement unit**>.
   d. Cache Buffer Size: <**Insert number and measurement unit**>.
   e. <**Insert requirements**>.

4. Video Card: <**Insert number and measurement unit**> of RAM.

D. Input and Output Ports:

1. Serial port.
2. Shared port for external keyboard or mouse.
3. Four USB 2.0 ports.
4. Ethernet port.
5. IEEE 1394 integrated port.
6. Serial infrared communications port.

E. Battery:

1. 9-cell, 81 Wh lithium ion battery and ac adapter.
2. Battery life of at least three years.
3. Battery charge time of less than three hours.
4. Spare Battery(ies). [**One**] [**Two**].

F. Keyboard:

1. 85-key [**backlit**]keyboard.
2. Full upper- and lowercase ASCII keyset.

G. Integral Pointing Device: Touchpad with two buttons or equivalent pointing device.

H. Display:

1. <**Insert inches (mm)**> diagonal or larger high-definition WLED color display.
2. Antiglare screen.
3. [**1920 by 1080**] <**Insert value**> pixel resolution.
4. Brightness: 300 nits.

I. Network Interface Card: Include card with connection, as application.

1. 10-100-1000 base TX Ethernet with RJ45 connector port.
2. 100 base FX Ethernet with SC or ST port.

J. Digital Video Disc Rewrite Recorder (DVD+/-RW):

1. Compatible with DVD disks and data, audio, recordable and rewritable compact disks.
2. Nominal Data Transfer Rates:

a. Reading: <**Insert number**> [**MB**] [**TB**]/s.
b. Writing: <**Insert number**> [**MB**] [**TB**]/s.

3. 160-ms access time.

K. Accessories:

1. Leather carrying case.
2. Docking station.
3. Wireless-N communication card.
4. Bluetooth module with 2.1 standard technologies.
5. Mobile broadband card.
6. Wireless optical mouse.
7. <**Insert value**> [**GB**] [**TB**] portable hard drive.
8. Light-sensitive Web cam and noise-cancelling digital array microphone.
9. Cable with network jackets on each end. Minimum cable length shall be <**Insert length**>.

2.12 POT

A. Description: Handheld device with integral keypad or touch screen operator interface.

B. Display: Multiple lines of text display for use in operator interaction with DDC system.

C. Cable: Flexible [**coiling**]cable, at least 36 inches (900 mm) long, with a plug-in jack for connection to DDC controllers, network ports or instruments with an integral LAN port. As an alternative to hardwired connection, POT shall be accessible to DDC controllers through a wireless network connection.

D. POT shall be powered through network connection.

E. Connection of POT to DDC system shall not interrupt or interfere with normal network operation in any way, prevent alarms from being transmitted, or preclude central initiated commands and system modification.

F. POT shall give operator the ability to do the following:

1. Display and monitor BI point status.
2. Change BO point set point (on or off, open or closed).
3. Display and monitor analog point values.
4. Change analog control set points.
5. Command a setting of AO point.
6. Display and monitor I/O point in alarm.
7. Add a new or delete an existing I/O point.
8. Enable and disable I/O points, initiators, and programs.
9. Display and change time and date.
10. Display and change time schedules.
11. Display and change run-time counters and run-time limits.
12. Display and change time and event initiation.
13. Display and change control application and DDC parameters.
14. Display and change programmable offset values.
15. Access DDC controller initialization routines and diagnostics.

2.13 SYSTEM SOFTWARE

A. System Software Minimum Requirements:

1. Real-time multitasking and multiuser 64-bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.
2. Operating system shall be capable of operating DOS and Microsoft Windows applications.
3. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
4. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
5. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
6. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

B. Operator Interface Software:

1. Minimize operator training through use of English language prorating and English language point identification.
2. Minimize use of a typewriter-style keyboard through use of a pointing device similar to a mouse.
3. Operator sign-off shall be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
4. Automatic sign-off period shall be programmable from one to 60 minutes in one-minute increments on a per operator basis.
5. Operator sign-on and sign-off activity shall be recorded and sent to printer.
6. Security Access:

    a. Operator access to DDC system shall be under password control.
    b. An alphanumeric password shall be field assignable to each operator.
    c. Operators shall be able to access DDC system by entry of proper password.

d. Operator password shall be same regardless of which computer or other interface means is used.
e. Additions or changes made to passwords shall be updated automatically.
f. Each operator shall be assigned an access level to restrict access to data and functions the operator is cable of performing.
g. Software shall have at least five access levels.
h. Each menu item shall be assigned an access level so that a one-for-one correspondence between operator assigned access level(s) and menu item access level(s) is required to gain access to menu item.
i. Display menu items to operator with those capable of access highlighted. Menu and operator access level assignments shall be online programmable and under password control.

7. Data Segregation:

a. Include data segregation for control of specific data routed to a workstation, to an operator or to a specific output device, such as a printer.
b. Include at least 32 segregation groups.
c. Segregation groups shall be selectable such as "fire points," "fire points on second floor," "space temperature points," "HVAC points," and so on.
d. Points shall be assignable to multiple segregation groups. Display and output of data to printer or monitor shall occur where there is a match of operator or peripheral segregation group assignment and point segregations.
e. Alarms shall be displayed and printed at each peripheral to which segregation allows, but only those operators assigned to peripheral and having proper authorization level will be allowed to acknowledge alarms.
f. Operators and peripherals shall be assignable to multiple segregation groups and all assignments are to be online programmable and under password control.

8. Operators shall be able to perform commands including, but not limited to, the following:

a. Start or stop selected equipment.
b. Adjust set points.
c. Add, modify, and delete time programming.
d. Enable and disable process execution.
e. Lock and unlock alarm reporting for each point.
f. Enable and disable totalization for each point.
g. Enable and disable trending for each point.
h. Override control loop set points.
i. Enter temporary override schedules.
j. Define holiday schedules.
k. Change time and date.
l. Enter and modify analog alarm limits.
m. Enter and modify analog warning limits.
n. View limits.
o. Enable and disable demand limiting.
p. Enable and disable duty cycle.
q. Display logic programming for each control sequence.

9. Reporting:

a. Generated automatically and manually.
b. Sent to displays, printers and disk files.
c. Types of Reporting:

1) General listing of points.

2) List points currently in alarm.
3) List of off-line points.
4) List points currently in override status.
5) List of disabled points.
6) List points currently locked out.
7) List of items defined in a "Follow-Up" file.
8) List weekly schedules.
9) List holiday programming.
10) List of limits and deadbands.

10. Summaries: For specific points, for a logical point group, for an operator selected group(s), or for entire system without restriction due to hardware configuration.

C. Graphic Interface Software:

1. Include a full interactive graphical selection means of accessing and displaying system data to operator. Include at least five levels with the penetration path operator assignable (for example, site, building, floor, air-handling unit, and supply temperature loop). Native language descriptors assigned to menu items are to be operator defined and modifiable under password control.
2. Include a hierarchical-linked dynamic graphic operator interface for accessing and displaying system data and commanding and modifying equipment operation. Interface shall use a pointing device with pull-down or penetrating menus, color and animation to facilitate operator understanding of system.
3. Include at least 10 levels of graphic penetration with the hierarchy operator assignable.
4. Descriptors for graphics, points, alarms and such shall be modified through operator's workstation under password control.
5. Graphic displays shall be online user definable and modifiable using the hardware and software provided.
6. Data to be displayed within a graphic shall be assignable regardless of physical hardware address, communication or point type.
7. Graphics are to be online programmable and under password control.
8. Points may be assignable to multiple graphics where necessary to facilitate operator understanding of system operation.
9. Graphics shall also contain software points.
10. Penetration within a graphic hierarchy shall display each graphic name as graphics are selected to facilitate operator understanding.
11. Back-trace feature shall permit operator to move upward in the hierarchy using a pointing device. Back trace shall show all previous penetration levels. Include operator with option of showing each graphic full screen size with back trace as horizontal header or by showing a "stack" of graphics, each with a back trace.
12. Display operator accessed data on the monitor.
13. Operator shall select further penetration using pointing device to click on a site, building, floor, area, equipment, and so on. Defined and linked graphic below that selection shall then be displayed.
14. Include operator with means to directly access graphics without going through penetration path.
15. Dynamic data shall be assignable to graphics.
16. Display points (physical and software) with dynamic data provided by DDC system with appropriate text descriptors, status or value, and engineering unit.
17. Use color, rotation, or other highly visible means, to denote status and alarm states. Color shall be variable for each class of points, as chosen by operator.
18. Points shall be dynamic with operator adjustable update rates on a per point basis from one second to over a minute.
19. For operators with appropriate privilege, points shall be commanded directly from display using pointing device.

a. For an analog command point such as set point, current conditions and limits shall be displayed and operator can position new set point using pointing device.
b. For a digital command point such as valve position, valve shall show its current state such as open or closed and operator could select alternative position using pointing device.
c. Keyboard equivalent shall be available for those operators with that preference.

20. Operator shall be able to split or resize viewing screen into quadrants to show one graphic on one quadrant of screen and other graphics or spreadsheet, bar chart, word processing, curve plot and other information on other quadrants on screen. This feature shall allow real-time monitoring of one part of system while displaying other parts of system or data to better facilitate overall system operation.
21. Help Features:

a. On-line context-sensitive help utility to facilitate operator training and understanding.
b. Bridge to further explanation of selected keywords. Document shall contain text and graphics to clarify system operation.

1) If help feature does not have ability to bridge on keywords for more information, a complete set of user manuals shall be provided in an indexed word-processing program, which shall run concurrently with operating system software.

c. Available for Every Menu Item:

1) Index items for each system menu item.

22. Graphic generation software shall allow operator to add, modify, or delete system graphic displays.

a. Include libraries of symbols depicting HVAC symbols such as fans, coils, filters, dampers, valves pumps, and electrical symbols similar to those indicated.
b. Graphic development package shall use a pointing device in conjunction with a drawing program to allow operator to perform the following:

1) Define background screens.
2) Define connecting lines and curves.
3) Locate, orient and size descriptive text.
4) Define and display colors for all elements.
5) Establish correlation between symbols or text and associated system points or other displays.

D. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:

1. Site plan showing each building, and additional site elements, which are being controlled or monitored by DDC system.
2. Plan for each building floor, including interstitial floors, and each roof level of each building, showing the following:

a. Room layouts with room identification and name.
b. Locations and identification of all monitored and controlled HVAC equipment and other equipment being monitored and controlled by DDC system.
c. Location and identification of each hardware point being controlled or monitored by DDC system.

3. Graphic display for each piece of equipment connected to DDC system through a data communications link. Include dynamic indication of all points associated with equipment.
4. DDC system network riser diagram that shows schematic layout for entire system including all networks and all controllers, gateways operator workstations and other network devices.

E. Customizing Software:

1. Software to modify and tailor DDC system to specific and unique requirements of equipment installed, to programs implemented and to staffing and operational practices planned.
2. Online modification of DDC system configuration, program parameters, and database using menu selection and keyboard entry of data into preformatted display templates.
3. As a minimum, include the following modification capability:

    a. Operator assignment shall include designation of operator passwords, access levels, point segregation and auto sign-off.
    b. Peripheral assignment capability shall include assignment of segregation groups and operators to consoles and printers, designation of backup workstations and printers, designation of workstation header points and enabling and disabling of print-out of operator changes.
    c. System configuration and diagnostic capability shall include communications and peripheral port assignments, DDC controller assignments to network, DDC controller enable and disable, assignment of command trace to points and application programs and initiation of diagnostics.
    d. System text addition and change capability shall include English or native language descriptors for points, segregation groups and access levels and action messages for alarms, run time and trouble condition.
    e. Time and schedule change capability shall include time and date set, time and occupancy schedules, exception and holiday schedules and daylight savings time schedules.
    f. Point related change capability shall include the following:

        1) System and point enable and disable.
        2) Run-time enable and disable.
        3) Assignment of points to segregation groups, calibration tables, lockout, and run time and to a fixed I/O value.
        4) Assignment of alarm and warning limits.

    g. Application program change capability shall include the following:

        1) Enable and disable of software programs.
        2) Programming changes.
        3) Assignment of comfort limits, global points, time and event initiators, time and event schedules and enable and disable time and event programs.

4. Software shall allow operator to add points, or groups of points, to DDC system and to link them to energy optimization and management programs. Additions and modifications shall be online programmable using operator workstation, downloaded to other network devices and entered into their databases. After verification of point additions and associated program operation, database shall be uploaded and recorded on hard drive and disk for archived record.
5. Include high-level language programming software capability for implementation of custom DDC programs. Software shall include a compiler, linker, and up- and down-load capability.

6. Include a library of DDC algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences. Also include, as a minimum, the following:

    a. Proportional control (P).
    b. Proportional plus integral (PI).
    c. Proportional plus integral plus derivative (PID).
    d. Adaptive and intelligent self-learning control.

        1) Algorithm shall monitor loop response to output corrections and adjust loop response characteristics according to time constant changes imposed.
        2) Algorithm shall operate in a continuous self-learning manner and shall retain in memory a stored record of system dynamics so that on system shut down and restart, learning process starts from where it left off.

7. Fully implemented intrinsic control operators including sequence, reversing, ratio, time delay, time of day, highest select AO, lowest select AO, analog controlled digital output, analog control AO, and digitally controlled AO.
8. Logic operators such as "And," "Or," "Not," and others that are part of a standard set available with a high-level language.
9. Arithmetic operators such as "Add," "Subtract," "Multiply," "Divide," and others that are part of a standard set available with a high-level language.
10. Relational operators such as "Equal To," "Not Equal To," "Less Than," "Greater Than," and others that are part of a standard set available with a high-level language.

F. Alarm Handling Software:

1. Include alarm handling software to report all alarm conditions monitored and transmitted through DDC controllers, gateways and other network devices.
2. Include first in, first out handling of alarms according to alarm priority ranking, with most critical alarms first, and with buffer storage in case of simultaneous and multiple alarms.
3. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to DDC system.
4. Alarms display shall include the following:

    a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
    b. "Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."
    c. Discrete per point alarm action message, such as "Call Maintenance Dept. Ext-5561."
    d. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.

5. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.
6. Send e-mail alarm messages to designated operators.
7. Send e-mail, page, text and voice messages to designated operators for critical alarms.
8. Alarms shall be categorized and processed by class.

    a. Class 1:

        1) Associated with fire, security and other extremely critical equipment monitoring functions; have alarm, trouble, return to normal, and acknowledge conditions printed and displayed.

2) Unacknowledged alarms to be placed in unacknowledged alarm buffer.
3) All conditions shall cause an audible sound and shall require individual acknowledgment to silence audible sound.

b. Class 2:

1) Critical, but not life-safety related, and processed same as Class 1 alarms, except do not require individual acknowledgment.
2) Acknowledgement may be through a multiple alarm acknowledgment.

c. Class 3:

1) General alarms; printed, displayed and placed in unacknowledged alarm buffer queues.
2) Each new alarm received shall cause an audible sound. Audible sound shall be silenced by "acknowledging" alarm or by pressing a "silence" key.
3) Acknowledgement of queued alarms shall be either on an individual basis or through a multiple alarm acknowledgement.
4) Alarms returning to normal condition shall be printed and not cause an audible sound or require acknowledgment.

d. Class 4:

1) Routine maintenance or other types of warning alarms.
2) Alarms to be printed only, with no display, no audible sound and no acknowledgment required.

9. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.
10. To ensure that no alarm records are lost, it shall be possible to assign a backup printer to accept alarms in case of failure of primary printer.

G. Reports and Logs:

1. Include reporting software package that allows operator to select, modify, or create reports using DDC system I/O point data available.
2. Each report shall be definable as to data content, format, interval and date.
3. Report data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on workstation for historical reporting.
4. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
5. Reports and logs shall be stored on workstation hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.
6. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.

H. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.

1. All I/O: With current status and values.
2. Alarm: All current alarms, except those in alarm lockout.
3. Disabled I/O: All I/O points that are disabled.
4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.

5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
6. Logs:

    a. Alarm history.
    b. System messages.
    c. System events.
    d. Trends.

I. Standard Trends:

1. Trend all I/O point present values, set points, and other parameters indicated for trending.
2. Trends shall be associated into groups, and a trend report shall be set up for each group.
3. Trends shall be stored within DDC controller and uploaded to hard drives automatically on reaching [**75**] <**Insert value**> of DDC controller buffer limit, or by operator request, or by archiving time schedule.
4. Preset trend intervals for each I/O point after review with Owner.
5. Trend intervals shall be operator selectable from 10 seconds up to 60 minutes. Minimum number of consecutive trend values stored at one time shall be 100 per variable.
6. When drive storage memory is full, most recent data shall overwrite oldest data.
7. Archived and real-time trend data shall be available for viewing numerically and graphically by operators.

J. Custom Trends: Operator shall be able to define a custom trend log for any I/O point in DDC system.

1. Each trend shall include interval, start time, and stop time.
2. Data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on [**workstation**] [**server**] hard drives.
3. Data shall be retrievable for use in spreadsheets and standard database programs.

K. Programming Software:

1. Include programming software to execute sequences of operation indicated.
2. Include programming routines in simple and easy to follow logic with detailed text comments describing what the logic does and how it corresponds to sequence of operation.
3. Programing software shall be any of the following:

    a. Graphic Based: Programming shall use a library of function blocks made from preprogrammed code designed for DDC control systems.

        1) Function blocks shall be assembled with interconnection lines that represent to control sequence in a flowchart.
        2) Programming tools shall be viewable in real time to show present values and logical results of each function block.

    b. Menu Based: Programming shall be done by entering parameters, definitions, conditions, requirements and constraints.
    c. Line by Line and Text Based: Programming shall declare variable types such as local, global, real, integer, and so on, at the beginning of the program. Use descriptive comments frequently to describe programming code.

4. Include means for detecting programming errors and testing software control strategies with a simulation tool before implementing in actual control. Simulation tool may be inherent with programming software or as a separate product.

L. Database Management Software:

1. Where a separate SQL database is used for information storage, DDC system shall include database management software that separates database monitoring and managing functions by supporting multiple separate windows.
2. Database secure access shall be accomplished using standard SQL authentication including ability to access data for use outside of DDC system applications.
3. Database management function shall include summarized information on trend, alarm, event, and audit for the following database management actions:

    a. Backup.
    b. Purge.
    c. Restore.

4. Database management software shall support the following:

    a. Statistics: Display database server information and trend, alarm, event, and audit information on database.
    b. Maintenance: Include method of purging records from trend, alarm, event and audit databases by supporting separate screens for creating a backup before purging, selecting database, and allowing for retention of a selected number of day's data.
    c. Backup: Include means to create a database backup file and select a storage location.
    d. Restore: Include a restricted means of restoring a database by requiring operator to have proper security level.

5. Database management software shall include information of current database activity, including the following:

    a. Ready.
    b. Purging record from a database.
    c. Action failed.
    d. Refreshing statistics.
    e. Restoring database.
    f. Shrinking a database.
    g. Backing up a database.
    h. Resetting Internet information services.
    i. Starting network device manager.
    j. Shutting down the network device manager.
    k. Action successful.

6. Database management software monitoring functions shall continuously read database information once operator has logged on.
7. Include operator notification through on-screen pop-up display and e-mail message when database value has exceeded a warning or alarm limit.
8. Monitoring settings window shall have the following sections:

    a. Allow operator to set and review scan intervals and start times.
    b. E-mail: Allow operator to create and review e-mail and phone text messages to be delivered when a warning or an alarm is generated.
    c. Warning: Allow operator to define warning limit parameters, set reminder frequency and link e-mail message.
    d. Alarm: Allow operator to define alarm limit parameters, set reminder frequency and link e-mail message.

e. Database Login: Protect system from unauthorized database manipulation by creating a read access and a write access for each of trend, alarm, event and audit databases as well as operator proper security access to restore a database.

9. Monitoring settings taskbar shall include the following informational icons:

a. Normal: Indicates by color and size, or other easily identifiable means that all databases are within their limits.
b. Warning: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their warning limit.
c. Alarm: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their alarm limit.

2.14 ASHRAE 135 GATEWAYS

A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to, chillers, VAV Boxes, and variable-speed drives.

B. Include gateways to connect BACnet to legacy systems, existing non-BACnet devices, and existing non-BACnet DDC-controlled equipment, only when specifically requested and approved by Owner.

C. Include with each gateway an interoperability schedule showing each point or event on legacy side that BACnet "client" will read, and each parameter that BACnet network will write to. Describe this interoperability of BACnet services, or BIBBs, defined in ASHRAE 135, Annex K.

D. Gateway Minimum Requirements:

1. Read and view all readable object properties on non-BACnet network to BACnet network and vice versa where applicable.
2. Write to all writeable object properties on non-BACnet network from BACnet network and vice versa where applicable.
3. Include single-pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet and vice versa.
4. Comply with requirements of Data Sharing Read Property, Data Sharing Write Property, Device Management Dynamic Device Binding-B, and Device Management Communication Control BIBBs according to ASHRAE 135.
5. Hardware, software, software licenses, and configuration tools for operator-to-gateway communications.
6. Backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.

2.15 ASHRAE 135 PROTOCOL ANALYZER

A. Analyzer and required cables and fittings for connection to ASHRAE 135 network.

B. Analyzer shall include the following minimum capabilities:

1. Capture and store to a file data traffic on all network levels.
2. Measure bandwidth usage.
3. Filtering options with ability to ignore select traffic.

2.16 DDC CONTROLLERS

A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.

E. Environment Requirements:

1. Controller hardware shall be suitable for the anticipated ambient conditions.
2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F (Zero to 50 deg C).
3. Controllers located outdoors shall be rated for operation at 40 to 150 deg F (40 to 65 deg C).

F. Power and Noise Immunity:

1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within36 inches (900 mm) of enclosure.

G. DDC Controller Spare Processing Capacity:

1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:

   a. Network Controllers: 60 percent.
   b. Programmable Application Controllers: Not less than 70 percent.
   c. Application-Specific Controllers: Not less than 80 percent.

2. Memory shall support DDC controller's operating system and database and shall include the following:

   a. Monitoring and control.
   b. Energy management, operation and optimization applications.
   c. Alarm management.
   d. Historical trend data of all connected I/O points.
   e. Maintenance applications.
   f. Operator interfaces.
   g. Monitoring of manual overrides.

H. DDC Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:

1. Network Controllers:

   a. 20 percent of each AI, AO, BI, and BO point connected to controller.

b. Minimum Spare I/O Points per Controller:

1) AIs: Two.
2) AOs: Two.
3) BIs: Three.
4) BOs: Three.

2. Programmable Application Controllers:

a. 10 percent of each AI, AO, BI, and BO point connected to controller.
b. Minimum Spare I/O Points per Controller:

1) AIs: Two.
2) AOs: Two.
3) BIs: Three.
4) BOs: Three.

3. Application-Specific Controllers:

a. 10 percent of each AI, AO, BI, and BO point connected to controller.
b. Minimum Spare I/O Points per Controller:

1) AIs: One.
2) AOs: One.
3) BIs: One.
4) BOs: One.

I. Maintenance and Support: Include the following features to facilitate maintenance and support:

1. Mount microprocessor components on circuit cards for ease of removal and replacement.
2. Means to quickly and easily disconnect controller from network.
3. Means to quickly and easily access connect to field test equipment.
4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.

J. Input and Output Point Interface:

1. Hardwired input and output points shall connect to network, programmable application and application-specific controllers.
2. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller.
3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.
4. AIs:

a. AIs shall include monitoring of low-voltage (zero- to 10-V dc), current (4 to 20 mA) and resistance signals from thermistor and RTD sensors.
b. AIs shall be compatible with, and field configurable to, sensor and transmitters installed.
c. Controller AIs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 12 bits or better to comply with accuracy requirements indicated.
d. Signal conditioning including transient rejection shall be provided for each AI.
e. Capable of being individually calibrated for zero and span.

f. Incorporate common-mode noise rejection of at least 50 dB from zero to 100 Hz for differential inputs, and normal-mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10000 ohms.

5. AOs:

a. Controller AOs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 12 bits or better to comply with accuracy requirements indicated.
b. Output signals shall have a range of 4 to 20 mA dc or zero- to 10-V dc as required to include proper control of output device.
c. Capable of being individually calibrated for zero and span.
d. AOs shall not exhibit a drift of greater than 0.4 percent of range per year.

6. BIs:

a. Controller BIs shall accept contact closures and shall ignore transients of less than 5-ms duration.
b. Isolation and protection against an applied steady-state voltage of up to 180-V ac peak.
c. BIs shall include a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against effects of contact bounce and noise.
d. BIs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
e. Pulse accumulation input points shall comply with all requirements of BIs and accept up to 10 pulses per second for pulse accumulation. Buffer shall be provided to totalize pulses. Pulse accumulator shall accept rates of at least 20 pulses per second. The totalized value shall be reset to zero on operator's command.

7. BOs:

a. Controller BOs shall include relay contact closures or triac outputs for momentary and maintained operation of output devices.

1) Relay contact closures shall have a minimum duration of 0.1 second. Relays shall include at least 180 V of isolation. Electromagnetic interference suppression shall be provided on all output lines to limit transients to non-damaging levels. Minimum contact rating shall be 1 A at 24-V ac.
2) Triac outputs shall include at least 180 V of isolation. Minimum contact rating shall be 1 A at 24-V ac.

b. BOs shall include for two-state operation or a pulsed low-voltage signal for pulse-width modulation control.
c. BOs shall be selectable for either normally open or normally closed operation.
d. Include tristate outputs (two coordinated BOs) for control of three-point floating-type electronic actuators without feedback.
e. Limit use of three-point floating devices to VAV terminal unit control applications,. Control algorithms shall operate actuator to one end of its stroke once every 12 hours for verification of operator tracking.

2.17 NETWORK CONTROLLERS

A. General Network Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers that perform scheduling shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.

B. Communication:

1. Network controllers shall communicate with other devices on DDC system Level one network.
2. Network controller also shall perform routing if connected to a network of programmable application and application-specific controllers.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or PDA.
2. Local Keypad and Display:

    a. Equip controller with local keypad and digital display for interrogating and editing data.
    b. Use of keypad and display shall require security password.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.18 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. Controller shall have enough memory to support its operating system, database, and programming requirements.
3. Data shall be shared between networked controllers and other network devices.
4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
5. Controllers that perform scheduling shall have a real-time clock.

6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
7. Controllers shall be fully programmable.

B. Communication:

1. Programmable application controllers shall communicate with other devices on network.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or PDA.
2. Local Keypad and Display:

a. Equip controller with local keypad and digital display for interrogating and editing data.
b. Use of keypad and display shall require security password.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.19 APPLICATION-SPECIFIC CONTROLLERS

A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.

1. Capable of standalone operation and shall continue to include control functions without being connected to network.
2. Data shall be shared between networked controllers and other network devices.

B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

C. Operator Interface: Controller shall be equipped with a service communications port for connection to a portable operator's workstation. Connection shall extend to port on space temperature sensor that is connected to controller.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

2.20 CONTROLLER SOFTWARE

A. General Controller Software Requirements:

1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.
2. I/O points shall be identified by up to 30-character point name and up to 16-character point descriptor. Same names shall be used at operator workstations.
3. Control functions shall be executed within controllers using DDC algorithms.
4. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.

B. Security:

1. Operator access shall be secured using individual security passwords and user names.
2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.
3. Operator log-on and log-off attempts shall be recorded.
4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.

C. Scheduling: Include capability to schedule each point or group of points in system. Each schedule shall consist of the following:

1. Weekly Schedule:

a. Include separate schedules for each day of week.
b. Each schedule should include the capability for start, stop, optimal start, optimal stop, and night economizer.
c. Each schedule may consist of up to 10 events.
d. When a group of objects are scheduled together, include capability to adjust start and stop times for each member.

2. Exception Schedules:

a. Include ability for operator to designate any day of the year as an exception schedule.
b. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by regular schedule for that day of week.

3. Holiday Schedules:

a. Include capability for operator to define up to 99 special or holiday schedules.
b. Schedules may be placed on scheduling calendar and will be repeated each year.
c. Operator shall be able to define length of each holiday period.

D. System Coordination:

1. Include standard application for proper coordination of equipment.
2. Application shall include operator with a method of grouping together equipment based on function and location.
3. Group may then be used for scheduling and other applications.

E. Binary Alarms:

1. Each binary point shall be set to alarm based on operator-specified state.
2. Include capability to automatically and manually disable alarming.

F. Analog Alarms:

1. Each analog object shall have both high and low alarm limits.
2. Alarming shall be able to be automatically and manually disabled.

G. Alarm Reporting:

1. Operator shall be able to determine action to be taken in event of an alarm.
2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.

H. Remote Communication:

1. System shall have ability to dial out in the event of an alarm.

I. Electric Power Demand Limiting:

1. Demand-limiting program shall monitor building or other operator-defined electric power consumption from signals connected to electric power meter or from a watt transducer or current transformer.
2. Demand-limiting program shall predict probable power demand such that action can be taken to prevent exceeding demand limit. When demand prediction exceeds demand limit, action will be taken to reduce loads in a predetermined manner. When demand prediction indicates demand limit will not be exceeded, action will be taken to restore loads in a predetermined manner.
3. Demand reduction shall be accomplished by the following means:

    a. Reset air-handling unit supply temperature set points.
    b. Reset space temperature set points.
    c. De-energize equipment based on priority.

4. Demand-limiting parameters, frequency of calculations, time intervals, and other relevant variables shall be based on the means by which electric power service provider computes demand charges.
5. Include demand-limiting prediction and control for any individual meter monitored by system or for total of any combination of meters.
6. Include means operator to make the following changes online:

    a. Addition and deletion of loads controlled.
    b. Changes in demand intervals.
    c. Changes in demand limit for meter(s).
    d. Maximum shutoff time for equipment.
    e. Minimum shutoff time for equipment.
    f. Select rotational or sequential shedding and restoring.
    g. Shed and restore priority.

7. Include the following information and reports, to be available on an hourly, daily, weekly, monthly and annual basis:

a. Total electric consumption.
b. Peak demand.
c. Date and time of peak demand.
d. Daily peak demand.

J. Maintenance Management: System shall monitor equipment status and generate maintenance messages based on operator-designated run-time, starts, and calendar date limits.

K. Sequencing: Include application software based on sequences of operation indicated to properly sequence chillers, boilers, and other applicable HVAC equipment.

L. Control Loops:

1. Support any of the following control loops, as applicable to control required:

a. Two-position (on/off, open/close, slow/fast) control.
b. Proportional control.
c. Proportional plus integral (PI) control.
d. Proportional plus integral plus derivative (PID) control.

1) Include PID algorithms with direct or reverse action and anti-windup.
2) Algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs.
3) Controlled variable, set point, and PID gains shall be operator-selectable.

e. Adaptive (automatic tuning).

M. Staggered Start: Application shall prevent all controlled equipment from simultaneously restarting after a power outage. Order which equipment (or groups of equipment) is started, along with the time delay between starts, shall be operator-selectable.

N. Energy Calculations:

1. Include software to allow instantaneous power or flow rates to be accumulated and converted to energy usage data.
2. Include an algorithm that calculates a sliding-window average (rolling average). Algorithm shall be flexible to allow window intervals to be operator specified (such as 15, 30, or 60 minutes).
3. Include an algorithm that calculates a fixed-window average. A digital input signal shall define start of window period (such as signal from utility meter) to synchronize fixed-window average with that used by utility.

O. Anti-Short Cycling:

1. BO points shall be protected from short cycling.
2. Feature shall allow minimum on-time and off-time to be selected.

P. On and Off Control with Differential:

1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
2. Algorithm shall be direct- or reverse-acting and incorporate an adjustable differential.

Q. Run-Time Totalization:

1. Include software to totalize run-times for all BI and BO points.
2. A high run-time alarm shall be assigned, if required, by operator.

2.21 ENCLOSURES

A. General Enclosure Requirements:

1. House each controller and associated control accessories in a single enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
2. Do not house more than one controller in a single enclosure.
3. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
4. Individual wall-mounted single-door enclosures shall not exceed 36 inches (900 mm) wide and 48 inches (1200 mm) high.
5. Individual wall-mounted double-door enclosures shall not exceed wide and 36 inches (900 mm) high.

B. Internal Arrangement:

1. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components associated with a controller, but not an integral part of controller.
2. Arrange layout to group similar products together.
3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
5. Terminate field cable and wire using heavy-duty terminal blocks.
6. Include spare terminals, equal to not less than [**10**] [**20**] <**Insert number**> percent of used terminals.
7. Include spade lugs for stranded cable and wire.
8. Install a maximum of two wires on each side of a terminal.
9. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
10. Mount products within enclosure on removable internal panel(s).
11. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch- (6-mm-) high lettering.
12. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.
13. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.
14. Size enclosure internal panel to include at least 25 percent spare area on face of panel.

C. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.
3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.

4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.
5. Include temperature-controlled cooling within the enclosure for applications where ventilation fans cannot maintain inside temperature of enclosure below maximum operating temperature of product with most stringent requirement.
6. Where required by application, include humidity-controlled electric dehumidifier or cooling to maintain inside of enclosure below maximum relative humidity of product with most stringent requirement and to prevent surface condensation within enclosure.

D. Wall-Mounted, NEMA 250, Type 1:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Hoffman; a brand of nVent.

2. Enclosure shall be NRTL listed according to UL 50 or UL 50E.
3. Construct enclosure of steel, not less than:

    a. Enclosure size less than 24 in. (600 mm): 0.053 in. (1.35 mm) thick.
    b. Enclosure size 24 in. (600 mm) and larger: 0.067 in. (1.7 mm) thick.

4. Finish enclosure inside and out with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Exterior color shall be white.
    b. Interior color shall be white.

5. Hinged door full size of front face of enclosure and supported using:

    a. Enclosures sizes less than 36 in. (900 mm) tall: Multiple butt hinges.
    b. Enclosures sizes 36 in. (900 mm) tall and larger: Continuous piano hinges.

6. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Size less than 24 in. (600 mm): Solid steel, 0.053 in. (1.35 mm) thick.
    b. Size 24 in. (600 mm) and larger: Solid aluminum, 0.10 in. (3 mm) thick.

7. Internal panel mounting hardware, grounding hardware and sealing washers.
8. Grounding stud on enclosure body.
9. Thermoplastic pocket on inside of door for record Drawings and Product Data.

E. Wall Mounted NEMA 250, Types 4 and 12:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Hoffman; a brand of nVent.

2. Enclosure shall be NRTL listed according to UL 508A.
3. Seam and joints are continuously welded and ground smooth.

4. Where recessed enclosures are indicated, include enclosures with face flange for flush mounting.
5. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
6. Single-door enclosure sizes up to 60 inches tall by 36 inches wide (1500 mm tall by 900 mm wide).
7. Double-door enclosure sizes up to 36 inches tall by 60 inches wide (900 mm tall by 1500 mm wide).
8. Construct enclosure of steel, not less than the following:

    a. Size Less Than 24 Inches (600 mm): 0.053 inch (1.35 mm) thick.
    b. Size 24 Inches (600 mm) and Larger: 0.067 inch (1.7 mm) thick.

9. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Exterior color shall be white.
    b. Interior color shall be white.

10. Corner-formed door, full size of enclosure face, supported using multiple concealed hinges with easily removable hinge pins.

    a. Sizes through 24 Inches (600 mm) Tall: Two hinges.
    b. Sizes between 24 Inches (600 mm) through 48 Inches (1200 mm) Tall: Three hinges.
    c. Sizes Larger 48 Inches (1200 mm) Tall: Four hinges.

11. Double-door enclosures with overlapping door design to include unobstructed full-width access.

    a. Single-door enclosures 48 inches (1200 mm) and taller, and all double-door enclosures, with three-point (top, middle and bottom) latch system.

12. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Size Less Than 24 Inches (600 mm): Solid steel, 0.053 inch (1.35 mm) thick.
    b. Size 24 Inches (600 mm) and Larger: Solid aluminum, 0.10 inch (3 mm) thick.

13. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
14. Grounding stud on enclosure body.
15. Thermoplastic pocket on inside of door for record Drawings and Product Data.

F. Wall-Mounted, NEMA 250, Type 4X SS:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Hoffman; a brand of nVent.

2. Enclosure shall be NRTL listed according to UL 508A.
3. Seam and joints are continuously welded and ground smooth.
4. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.

5. Construct enclosure of Type 304 stainless steel, not less than the following:

    a. Size Less Than 24 Inches (600 mm): 0.053 inch (1.35 mm) thick.
    b. Size 24 Inches (600 mm) and Larger: 0.067 inch (1.7 mm) thick.

6. Outside body and door of enclosure with brushed No. 4 finish.

7. Corner-formed door, full size of enclosure face, supported using continuous piano hinge full length of door.
8. Doors fitted with three-point (top, middle, and bottom) latch system with single, heavy-duty, liquid-tight Type 316 stainless-steel handle with integral locking mechanism.
9. Removable internal panel shall be 0.093-inch (2.36-mm) solid steel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
10. Internal panel mounting studs and hardware, grounding hardware, and sealing washers.
11. Install corrosion-resistant polyester vent drain in a stainless-steel sleeve at the bottom of enclosure.
12. Include enclosure with stainless-steel mounting brackets.

G. Freestanding, NEMA 250, Type 1:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Hoffman; a brand of nVent.

2. Enclosure shall be NRTL listed according to UL 508A.
3. Seam and joints are continuously welded and ground smooth.
4. Externally formed body flange around perimeter of enclosure face.
5. Single-door enclosure sizes up to 84 inches tall by 36 inches wide (2100 mm tall by 900 mm wide).
6. Double-door enclosure sizes up to 84 inches tall by 72 inches wide (2100 mm tall by 900 mm wide).
7. Construct enclosure of steel, not less than 0.067 inch (1.7 mm) thick.
8. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Exterior color shall be white.
    b. Interior color shall be white.

9. Corner-formed flush door, full size of enclosure face, supported using four concealed hinges with easily removable hinge pins.
10. Double-door enclosures with overlapping door design to include unobstructed full-width access.
11. Doors with three-point (top, middle, and bottom) latch system with single heavy-duty handle and integral locking mechanism.
12. Removable back covers.
13. Removable solid steel internal panel, 0.093 inch (2.36 mm) thick, with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
14. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
15. Grounding stud on enclosure body.
16. Thermoplastic pocket on inside of door for record Drawings and Product Data.
17. Nominal 4-inch- (100-mm-) tall integral lifting base, not less than 0.123 inch (3.12 mm) thick, with predrilled holes for attachment to mounting surface.
18. Each top end of enclosure fitted with lifting tabs, not less than 0.172 inch (4.37 mm) thick.

19. Internal rack-mount shelves and angles as required by application.

H. Freestanding, NEMA 250, Types 4 and 12:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Hoffman; a brand of nVent.

2. Enclosure shall be NRTL listed according to UL 508A.
3. Seam and joints are continuously welded and ground smooth.
4. Externally formed body flange around perimeter of enclosure face.
5. Type 12 Enclosure Sizes:

   a. Single-door enclosure sizes up to 90 inches tall by 36 inches wide (2250 mm tall by 900 mm wide).
   b. Double-door enclosure sizes up to 90 inches tall by 72 inches wide (2250 mm tall by 900 mm wide).

6. Type 4 Enclosure Sizes:

   a. Single-door enclosure sizes up to 72 inches tall by 36 inches wide (1800 mm tall by 900 mm wide).

7. Construct enclosure of steel, not less than 0.093 inch (2.36 mm) thick.
8. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

   a. Exterior color shall be white.
   b. Interior color shall be white.

9. Corner-formed door with continuous perimeter oil-resistant gasket supported using continuous piano hinge full length of door.
10. Doors fitted with three-point (top, middle, and bottom) latch system with latching rod rollers and single, heavy-duty oil-tight handle with integral locking mechanism.
11. Removable solid steel internal panel, 0.093 inch (2.36 mm) thick, with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
12. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
13. Grounding stud on enclosure body.
14. Thermoplastic pocket on inside of door for record Drawings and Product Data.
15. Top of enclosure fitted with no fewer than two lifting eyes.
16. Internal rack-mount shelves and angles as required by application.

I. Accessories:

1. Electric Heater:

   a. Aluminum housing with brushed finish.
   b. Thermostatic control with adjustable set point from zero to 100 deg F (Minus 18 to 38 deg C).
   c. Capacity: 100, 200, 400, and 800 W as required by application.
   d. Fan draws cool air from bottom of enclosure and passes air across thermostat and heating elements before being released into enclosure cavity. Heated air is discharged through the top of heater.

2. Ventilation Fans, Filtered Intake and Exhaust Grilles:

    a. Number and size of fans, filters and grilles as required by application.
    b. Compact cooling fans engineered for 50,000 hours of continuous operation without lubrication or service.
    c. Fans capable of being installed on any surface and in any position within enclosure for spot cooling or air circulation.
    d. Thermostatic control with adjustable set point from 32 to 140 deg F (Zero to 60 deg C).
    e. Airflow Capacity at Zero Pressure:

        1) 4-Inch (100-mm) Fan: 100 cfm (47 L/s).
        2) 6-Inch (150-mm) Fan: 240 cfm (113 L/s).
        3) 10-Inch (250-mm) Fan: 560 cfm (264 L/s).

    f. Maximum operating temperature of 158 deg F (70 deg C).
    g. 4-inch (100-mm) fan thermally protected and provided with permanently lubricated ball-bearings.
    h. 6- and 10-inch (150- and 250-mm) fans with ball-bearing construction and split capacitor motors thermally protected to avoid premature failure.
    i. Dynamically balanced impellers molded from polycarbonate material.
    j. Fan furnished with power cord and polarized plug for power connection.
    k. Fan brackets, finger guards and mounting hardware provided with fans to complete installation.
    l. Removable Intake and Exhaust Grilles: stainless steel of size to match fan size and suitable for NEMA 250, Types 1 and 12 enclosures.
    m. Filters for NEMA 250, Type 1 Enclosures: Washable aluminum, of a size to match intake grille.
    n. Filters for NEMA 250, Type 12 Enclosures: Disposable, of a size to match intake grille.

3. Air Conditioner:

    a. Electric-powered, self-contained air-conditioning unit specially designed for electrical enclosures to maintain temperature inside enclosure below ambient temperature outside enclosure.
    b. Thermostatic control with adjustable set point from 60 to 120 deg F (16 to 49 deg C).
    c. Enclosure side or top mounting with unit capacity as required by application.
    d. Designed for closed-loop cooling with continuous operation in ambient environments up to 125 deg F (52 deg C).
    e. HFC refrigerant.
    f. Reusable and washable air filter.
    g. High-performance, industrial-grade, and high-efficiency fans.
    h. Furnished with power cord and polarized plug for power connection.
    i. Condensate management system with base pan side drain.
    j. Mounting hardware, gaskets, mounting template and instruction manual furnished with unit.
    k. Outdoor units equipped with head pressure control for low ambient operation, compressor heater, coated condenser coil and thermostat.

4. Thermoelectric Humidifier:

    a. ABS plastic enclosure.
    b. Capacity of 8 oz. (0.24 L) of water per 24 hours.

c. Built-in drain captures moisture and plastic hose directs moisture to outside enclosure through a drain.
d. Controlled to maintain enclosure relative humidity at an adjustable set point.
e. Unit power supply shall be internally wired to enclosure electrical power source.

5. Framed Fixed Window Kit for NEMA 250, Types 4, 4X, and 12 Enclosures:

a. 0.25-inch- (6-mm-) thick, scratch-resistant acrylic or polycarbonate window mounted in a metal frame matching adjacent door material.
b. Enclosure types, except NEMA 250 Type 1, shall have a continuous gasket material around perimeter of window and frame to provide watertight seal.
c. Window kit shall be factory or shop installed before shipment to Project.

6. Frameless Fixed Window Kit for NEMA 250, Type 1 Enclosures:

a. 0.125-inch- (3-mm-) thick, polycarbonate window mounted in enclosure door material.
b. Window attached to door with screw fasteners and continuous strip of high-strength double-sided tape around window perimeter.
c. Window kit shall be factory or shop installed before shipment to Project.

7. Frame Fixed or Hinged Window Kit for NEMA 250, Types 1 and 12 Enclosures:

a. 0.25-inch- (6-mm-) thick, scratch-resistant acrylic or polycarbonate window mounted in a metal frame matching adjacent door material.
b. Enclosure types, except NEMA 250 Type 1, shall have a continuous gasket material around perimeter of window and frame to provide watertight seal.
c. Window kit shall be factory or shop installed before shipment to Project.

8. Bar handle with keyed cylinder lock set.

2.22 RELAYS

A. General-Purpose Relays:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Siemens Industry, Inc., Building Technologies Division.

2. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.
3. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
4. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three-pole double-throw relays.
5. Construct the contacts of either silver cadmium oxide or gold.
6. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
7. Relays shall have LED indication and a manual reset and push-to-test button.
8. Performance:

a. Mechanical Life: At least 10 million cycles.
b. Electrical Life: At least 100,000 cycles at rated load.
c. Pickup Time: 15 ms or less.

d. Dropout Time: 10 ms or less.
e. Pull-in Voltage: 85 percent of rated voltage.
f. Dropout Voltage: 50 percent of nominal rated voltage.
g. Power Consumption: 2 VA.
h. Ambient Operating Temperatures: Minus 40 to 115 deg F (Minus 40 to 46 deg C).

9. Equip relays with coil transient suppression to limit transients to non-damaging levels.
10. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
11. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

B. Multifunction Time-Delay Relays:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Siemens Industry, Inc., Building Technologies Division.

2. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.
3. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
4. Use a plug-in-style relay with either an 8- or 11-pin octal plug.
5. Construct the contacts of either silver cadmium oxide or gold.
6. Enclose the relay in a dust-tight cover.
7. Include knob and dial scale for setting delay time.
8. Performance:

   a. Mechanical Life: At least 10 million cycles.
   b. Electrical Life: At least 100,000 cycles at rated load.
   c. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
   d. Repeatability: Within 2 percent.
   e. Recycle Time: 45 ms.
   f. Minimum Pulse Width Control: 50 ms.
   g. Power Consumption: 5 VA or less at 120-V ac.
   h. Ambient Operating Temperatures: Minus 40 to 115 deg F (Minus 40 to 46 deg C).

9. Equip relays with coil transient suppression to limit transients to non-damaging levels.
10. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
11. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

C. Latching Relays:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Siemens Industry, Inc., Building Technologies Division.

2. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.
3. Relays shall be either DPDT or three-pole double throw, depending on the control application.

4. Use a plug-in-style relay with a multibladed plug.
5. Construct the contacts of either silver cadmium oxide or gold.
6. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
7. Performance:

    a. Mechanical Life: At least 10 million cycles.
    b. Electrical Life: At least 100,000 cycles at rated load.
    c. Pickup Time: 15 ms or less.
    d. Dropout Time: 10 ms or less.
    e. Pull-in Voltage: 85 percent of rated voltage.
    f. Dropout Voltage: 50 percent of nominal rated voltage.
    g. Power Consumption: 2 VA.
    h. Ambient Operating Temperatures: Minus 40 to 115 deg F (Minus 40 to 46 deg C).

8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

D. Current Sensing Relay:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Square D; by Schneider Electric.

2. Monitors ac current.
3. Independent adjustable controls for pickup and dropout current.
4. Energized when supply voltage is present and current is above pickup setting.
5. De-energizes when monitored current is below dropout current.
6. Dropout current is adjustable from 50 to 95 percent of pickup current.
7. Include a current transformer, if required for application.
8. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

E. Combination On-Off Status Sensor and On-Off Relay:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Functional Devices Inc.

2. Description:

    a. On-off control and status indication in a single device.
    b. LED status indication of activated relay and current trigger.
    c. Closed-Open-Auto override switch located on the load side of the relay.

3. Performance:

    a. Ambient Temperature: Minus 30 to 140 deg F (Minus 34 to 60 deg C).

b. Voltage Rating: Single-phase loads rated for 300-V ac. Three-phase loads rated for 600-V ac.

4. Status Indication:

a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.
b. Current Sensor Range: As required by application.
c. Current Set Point: Fixed or adjustable as required by application.
d. Current Sensor Output:

5. Relay: Single-pole double-throw, continuous-duty coil; rated for 10-million mechanical cycles.
6. Enclosure: NEMA 250, Type 1 enclosure.

2.23 ELECTRICAL POWER DEVICES

A. Transformers:

1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
2. Transformer shall be at least 40 VA.
3. Transformer shall have both primary and secondary fuses.

B. Power-Line Conditioner:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Controlled Power Company; an Emerson company.

2. General Power-Line Conditioner Requirements:

a. Design to ensure maximum reliability, serviceability and performance.
b. Overall function of the power-line conditioner is to receive raw, polluted electrical power and purify it for use by electronic equipment. The power-line conditioner shall provide isolated, regulated, transient and noise-free sinusoidal power to loads served.

3. Standards: NRTL listed per UL 1012.
4. Performance:

a. Single phase, continuous, 100 percent duty rated KVA/KW capacity. Design to supply power for linear or nonlinear, high crest factor, resistive and reactive loads.
b. Automatically regulate output voltage to within 2 percent or better with input voltage fluctuations of plus 10 to minus 20 percent of nominal when system is loaded 100 percent. Use Variable Range Regulation to obtain improved line voltage regulation when operating under less than full load conditions.

1) At 75 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 35 percent of nominal.

2) At 50 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 40 percent of nominal.
3) At 25 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 45 percent of nominal.

c. With input voltage distortion of up to 40 percent, limit the output voltage sine wave to a maximum harmonic content of 5 percent.
d. Automatically regulate output voltage to within 2.5 percent when load (resistive) changes from zero percent to 100 percent to zero percent.
e. Output voltage returns to 95 percent of nominal level within two cycles and to 100 percent within three cycles when the output is taken from no load to full resistive load or vice-versa. Recovery from partial resistive load changes is corrected in a shorter period of time.
f. K Factor: 30, designed to operate with nonlinear, non-sinusoidal, high crest factor loads without overheating.
g. Input power factor within 0.95 approaching unity with load power factor as poor as 0.6.
h. Attenuate load-generated odd current harmonics 23 dB at the input.
i. Electrically isolate the primary from the secondary. Meet isolation criteria as defined in NFPA 70, Article 250-5D.
j. Lighting and Surge Protection: Compares to UL 1449 rating of 330 V when subjected to Category B3 (6000 V/3000 A) combination waveform as established by IEEE C62.41.
k. Common-mode noise attenuation of 140 dB.
l. Transverse-mode noise attenuation of 120 dB.
m. With loss of input power for up to 16.6 ms, the output sine wave remains at usable ac voltage levels.
n. Reliability of 200,000 hours' MTBF.
o. At full load, when measured at 1-m distance, audible noise is not to exceed 54 dB.
p. Approximately 92 percent efficient at full load.

5. Transformer Construction:

a. Ferroresonant, dry type, convection cooled, 600V class. Transformer windings of Class H (220 deg C) insulated copper.
b. Use a Class H installation system throughout with operating temperatures not to exceed 150 deg C over a 40-deg C ambient temperature.
c. Configure transformer primary for multi-input voltage. Include input terminals for source conductors and ground.
d. Manufacture transformer core using M-6 grade, grain-oriented, stress-relieved transformer steel.
e. Configure transformer secondary in a 240/120-V split with a 208-V tap or straight 120 V, depending on power output size.
f. Electrically isolate the transformer secondary windings from the primary windings. Bond neutral conductor to cabinet enclosure and output neutral terminal.
g. Include interface terminals for output power hot, neutral and ground conductors.
h. Label leads, wires and terminals to correspond with circuit wiring diagram.
i. Vacuum impregnate transformer with epoxy resin.

6. Cabinet Construction:

a. Design for panel or floor mounting.
b. NEMA 250, Type 1, general-purpose, indoor enclosure.
c. Manufacture the cabinet from heavy gauge steel complying with UL 50.

d. Include a textured baked-on paint finish.

C. Transient Voltage Suppression and High-Frequency Noise Filter Unit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Current Technology Inc.

2. The maximum continuous operating voltage shall be at least 125 percent.
3. The operating frequency range shall be 47 to 63 Hz.
4. Protection modes according to NEMA LS-1.
5. The rated single-pulse surge current capacity, for each mode of protection, shall be no less than the following:

   a. Line to Neutral: 45,000 A.
   b. Neutral to Ground: 45,000 A.
   c. Line to Ground: 45,000 A.
   d. Per Phase: 90,000 A.

6. Clamping voltages shall be in compliance with test and evaluation procedures defined in NEMA LS-1. Maximum clamping voltage shall be as follows:

   a. Line to Neutral: 360 V.
   b. Line to Ground: 360 V.
   c. Neutral to Ground: 360 V.

7. Electromagnetic interference and RF interference noise rejection or attenuation values shall comply with test and evaluation procedures defined in NEMA LS-1.

   a. Line to Neutral:

      1) 100 kHz: 42 dB.
      2) 1 MHz: 25 dB.
      3) 10 MHz: 21 dB.
      4) 100 MHz: 36 dB.

   b. Line to Ground:

      1) 100 kHz: 16 dB.
      2) 1 MHz: 55 dB.
      3) 10 MHz: 81 dB.
      4) 100 MHz: 80 dB.

8. Unit shall have LED status indicator that extinguishes to indicate a failure.
9. Unit shall be listed by an NRTL as a transient voltage surge suppressor per UL 1449, and as an electromagnetic interference filter per UL 1283.
10. Unit shall not generate any appreciable magnetic field.
11. Unit shall not generate an audible noise.

D. DC Power Supply:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Acopian Technical Company.

2. Plug-in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.
3. Enclose circuitry in a housing.
4. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.
5. Performance:

    a. Output voltage nominally 25-V dc within 5 percent.
    b. Output current up to 100 mA.
    c. Input voltage nominally 120-V ac, 60 Hz.
    d. Load regulation within 0.5 percent from zero- to 100-mA load.
    e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.
    f. Stability within 0.1 percent of rated volts for 24 hours after a 20-minute warmup.

2.24 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS

A. 250 through 1000 VA:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Oneac-Powervar Solutions; Powervar, Inc.

2. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
3. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.

    a. Larger-capacity units shall be provided for systems with larger connected loads.
    b. UPS shall provide five minutes of battery power.

4. Performance:

    a. Input Voltage: Single phase, 120- or 230-V ac, compatible with field power source.
    b. Load Power Factor Range (Crest Factor): 0.65 to 1.0.
    c. Output Voltage: 101- to 132-V ac, while input voltage varies between 89 and 152-V ac.
    d. On Battery Output Voltage: Sine wave.
    e. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
    f. Recharge time shall be a maximum of six hours to 90 percent capacity after full discharge to cutoff.
    g. Transfer Time: 6 ms.
    h. Surge Voltage Withstand Capacity: IEEE C62.41, Categories A and B; 6 kV/200 and 500 A; 100-kHz ringwave.

5. UPS shall be automatic during fault or overload conditions.

6. Unit with integral line-interactive, power condition topology to eliminate all power contaminants.
7. Include front panel with power switch and visual indication of power, battery, fault and temperature.
8. Unit shall include an audible alarm of faults and front panel silence feature.
9. Unit with four NEMA WD 1, NEMA WD 6 Configuration 5-15R receptacles.
10. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure) and connect the points to the DDC system.
11. Batteries shall be sealed lead-acid type and be maintenance free. Battery replacement shall be front accessible by user without dropping load.
12. Include tower models installed in ventilated cabinets to the particular installation location.

B. 1000 through 3000 VA:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Toshiba International Corporation.

2. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
3. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.

    a. Larger-capacity units, or multiple units, shall be provided for systems with larger connected loads.
    b. UPS shall provide 10 minutes of battery power.

4. Performance:

    a. Input Voltage: Single phase, 120-V ac, plus 20 to minus 30 percent.
    b. Power Factor: Minimum 0.97 at full load.
    c. Output Voltage: Single phase, 120-V ac, within 3 percent, steady state with rated output current of 10.0 A, 30.0-A peak.
    d. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
    e. Recharge time shall be a maximum of eight hours to 90 percent capacity.

5. UPS bypass shall be automatic during fault or overload conditions.
6. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure) and connect the points to the DDC system.
7. Batteries shall be sealed lead-acid type and be maintenance free.
8. Include tower models installed in ventilated cabinets or rack models installed on matching racks, as applicable to the particular installation location and space availability/configuration.

2.25 PIPING AND TUBING

A. Pneumatic, and Pressure Instrument Signal Air, Tubing and Piping:

1. Products in this paragraph are intended for use with the following:

    a. Main air and signal air to pneumatically controlled instruments, actuators and other control devices and accessories.

b. Signal air between pressure instruments, such as sensors, switches, transmitters, controllers and accessories.

2. Copper Tubing:

a. Seamless phosphor deoxidized copper, soft annealed or drawn tempered, with chemical and physical properties according to ASTM B 75.
b. Performance, dimensions, weight and tolerance according to ASTM B 280.
c. Diameter, as required by application, not less than nominal 0.25 inch (6 mm).
d. Wall thickness, as required by the application, but not less than 0.030 inch (0.8 mm).

3. Copper Tubing Connectors and Fittings:

a. Brass, compression type.

1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a) Parker Hannifin Corporation.

b. Brass, solder-joint type.

1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a) Paul Mueller Company.

4. Galvanized-Steel Piping:

a. Galvanized pipe shall be ASTM A 53/A 53M, Schedule 40.
b. Fittings, galvanized malleable iron, ASME B16.3, Class 150.

5. Polyethylene Tubing:

a. Fire-resistant black virgin polyethylene according to ASTM D 1248, Type 1, Class C and Grade 5.
b. Tubing shall comply with stress crack test according to ASTM D 1693.
c. Diameter, as required by application, of not less than nominal 0.25 inch (6 mm).

6. Polyethylene Tubing Connectors and Fittings:

a. Brass, barbered fittings.

1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a) Parker Hannifin Corporation.

b. Brass, compression type.

1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a) Parker Hannifin Corporation.

B. Process Tubing:

1. Products in this paragraph are intended for signals to instruments connected to liquid and steam systems.
2. Copper Tubing:

a. Seamless phosphor deoxidized copper, soft annealed or drawn tempered with chemical and physical properties according to ASTM B 75.
b. Performance, dimensions, weight and tolerance according to ASTM B 280.
c. Diameter, as required by application, of not less than nominal 0.25 inch (6 mm).
d. Wall thickness, as required by application, but not less than 0.030 inch (0.8 mm).

3. Copper Tubing Connectors and Fittings:

a. Brass, compression type.

1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a) Parker Hannifin Corporation.

b. Brass, solder-joint type.

1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a) Parker Hannifin Corporation.

4. Stainless-Steel Tubing:

a. Seamless Type 316 stainless steel, Grade TP, cold drawn, annealed and pickled, free from scale.
b. Chemical and physical properties according to ASTM A 269.
c. Diameter, as required by application, of not less than nominal 0.25 inch (6 mm).
d. Wall thickness, as required by application, but not less than 0.035 inch (0.9 mm).
e. Furnish stainless-steel tubing in [**20-foot (6-mm)**] straight random lengths.

5. Stainless-Steel Tubing Connectors and Fittings:

a. Connectors and fittings shall be stainless steel, with stainless-steel collets, flareless type.

1) <Double click here to find, evaluate, and insert list of manufacturers and products.>

b. Connect instruments to tubing with connectors having compression connector on one end and IPS or NPT thread on other end.

2.26 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.

1. Wire size shall be at least No. 16 AWG.
2. Conductor shall be 7/24 soft annealed copper strand with 2- to 2.5-inch (50- to 65-mm) lay.
3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
4. Conductor colors shall be black (hot), white (neutral), and green (ground).
5. Furnish wire on spools.

B. Single Twisted Shielded Instrumentation Cable above 24 V:

1. Wire size shall be a minimum No. 20 AWG.
2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch (50- to 65-mm) lay.
3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
4. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 600-V, 90-deg C rating and shall be Type TC cable.
6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
7. Furnish wire on spools.

C. Single Twisted Shielded Instrumentation Cable 24 V and Less:

1. Wire size shall be a minimum No. 20 AWG.
2. Conductors shall be a twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch (50- to 65-mm) lay.
3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
4. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 300-V, 105-deg C rating and shall be Type PLTC cable.
6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
7. Furnish wire on spools.

D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.

1. Cable shall be plenum rated.
2. Cable shall comply with NFPA 70.
3. Cable shall have a unique color that is different from other cables used on Project.
4. Copper Cable for Ethernet Network:

    a. 100BASE-TX 1000BASE-T or 1000BASE-TX.
    b. TIA/EIA 586, Category 5e or Category 6.
    c. Minimum No. 22 AWG solid.
    d. Shielded Twisted Pair (STP).
    e. Thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket, Class CMP as plenum rated.

2.27 RACEWAYS FOR CONTROL WIRING, CABLING, AND TUBING

A. Metal Conduits, Tubing, and Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems; a part of Atkore International.
    b. Anamet Electrical, Inc.
    c. Current Technology Inc.
    d. Southwire Company.
    e. Western Tube and Conduit Corporation.
    f. Wheatland Tube Company.

2. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with NEMA ANSI C80.1 and UL 6.
4. ARC: Comply with NEMA ANSI C80.5 and UL 6A.
5. IMC: Comply with NEMA ANSI C80.6 and UL 1242.
6. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

    a. Comply with NEMA RN 1.
    b. Coating Thickness: 0.040 inch (1 mm), minimum.

7. EMT: Comply with NEMA ANSI C80.3 and UL 797.
8. FMC: Comply with UL 1; zinc-coated steel or aluminum.
9. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
10. Fittings for Metal Conduit: Comply with NEMA ANSI FB 1 and UL 514B.

    a. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
    b. Fittings for EMT:

        1) Material: Steel or die cast.
        2) Type: Setscrew or compression.

    c. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
    d. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

11. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

B. Nonmetallic Conduits, Tubing, and Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems; a part of Atkore International.
    b. Anamet Electrical, Inc.
    c. CertainTeed Corporation.

2. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. ENT: Comply with NEMA TC 13 and UL 1653.
4. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
5. LFNC: Comply with UL 1660.
6. Rigid HDPE: Comply with UL 651A.
7. Continuous HDPE: Comply with UL 651A.
8. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
9. RTRC: Comply with UL 2515A and NEMA TC 14.
10. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
11. Fittings for LFNC: Comply with UL 514B.

C. Metal Wireways and Auxiliary Gutters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. B-line, an Eaton business.
   b. Hoffman; a brand of nVent.
   c. MonoSystems, Inc.
   d. Square D; by Schneider Electric.

2. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.

   a. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
4. Wireway Covers: Hinged type unless otherwise indicated.
5. Finish: Manufacturer's standard enamel finish.

D. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color as selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. MonoSystems, Inc.
   b. Panduit Corp.
   c. Wiremold / Legrand.

2.28 CONTROL POWER WIRING AND RACEWAYS

A. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" electrical power conductors and cables.

B. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

2.29 FIBER-OPTIC CABLE, CONNECTORS, AND RACEWAY

A. Cables:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AT&T.
   b. Communications Specialties, Inc.
   c. Corning Cable Systems.
   d. Optical Cable Corporation.

2. Performance Requirements:

   a. Fiber: Multimode graded index. Core/cladding size shall be either 62.5/125 or 100/140 micrometers.
   b. Numerical Aperture:

      1) 62.5/125 Micrometer Fiber: 0.275 plus or minus 0.015.
      2) 100/140 Micrometer Fiber: 0.29 plus or minus 0.015.

   c. Maximum Attenuation:

      1) 850 nm: 6.0 dB/km.
      2) 1300 nm: 5.0 dB/km.

   d. Minimum Bandwidth Dispersion: 300 Mhz-km at 850 nm.
   e. Core/Cladding Index Difference: 0.3 percent plus or minus 0.05 percent, measured using refractive rear field measurement procedure.
   f. Color-code finished fibers for easy identification.
   g. Splice Loss: Fibers shall be spliced together to form a longer fiber using a commercially available fiber splicing machine recommended by cable manufacturer. Maximum loss per fiber splice shall be 0.20 dB.
   h. Connection: Fibers shall be connected using fiber-optic connectors. Nominal connector loss shall not be greater than 1 dB.
   i. Fiber-optic cable shall be suitable for use with 100Base-FX or 100Base-SX standard (as applicable) as defined in IEEE 802.3.

3. Mechanical and Environmental Requirements:

   a. Tensile Strength: Fiber cable shall withstand a minimum tensile strength of 2700 N with maximum elongation of less than 0.5 percent.
   b. Bending Radius: Minimum static bending radius for cable shall be 10 times outside diameter for non-armored cables and 20 times outside diameter for armored cables. Non-armored cables shall withstand being flexed at minimum static bending radius plus or minus 90 degrees for at least 20 cycles at 20 to 40 cycles per minute at 20 deg C. Armored cables shall withstand being flexed at minimum static bending radius plus or minus 90 degrees for at least 10 cycles at 20 to 40 cycles per minute at 20 deg C.
   c. Vibration: Cable shall withstand a vibration test with vibration amplitude of 5 mm and frequency of 10 cycles per second for at least five hours.

d. Twist: Cable shall withstand twisting of 360 degrees over a length of 2 m for at least 10 cycles at 10 cycles per minute.
e. Temperature: Cable shall withstand the following temperatures:

1) Installation: Minus 30 to 70 deg C.
2) Operation: Minus 40 to 70 deg C.
3) Storage/Shipping: Minus 40 to 70 deg C.

f. Lifetime: Average lifetime of a 2-km, 12-fiber cable shall be at least 20 years when installed in a natural ambient environment. End of useful life shall be reached if failing to comply with requirements indicated or a spontaneous catastrophic fiber failure.
g. Crush Resistance: Cable shall withstand a compressive force of 705 N/cm for armored cables and 600 N/cm for non-armored cables. There shall be no attenuation increase after force is removed.

4. Cable Structure:

a. Number of Fibers: Supply the required number of fibers in each cable for DDC system indicated, plus not less than 50 percent spare. Cable structure shall have fibers grouped for easy handling.
b. Strength Members: Include cable with strength members to satisfy mechanical and environmental conditions indicated.
c. Cable Core: Core shall consist of stranded buffer tubes around a central member of appropriate geometric size and shall be filled and bound to maintain core integrity. A fibrous strength member may be stranded around core to provide necessary strength for cable.
d. Cable Jacket: Protect cable by an extruded-polyethylene jacket.
e. Cable Armor: For cables requiring extra mechanical protection, one or two layers of galvanized corrugated steel tape coated by an anticorrosive compound shall be either helically or longitudinally applied over standard outer jacket. Apply a second outer jacket of polyethylene over coated steel tape. Thickness of sheaths and jackets are not specified as long as mechanical and environmental conditions are satisfied.
f. Cable Installation: Cables shall be suitable for a semiprotected outdoor installation.

5. Packaging and Shipping:

a. Seal both ends of each length of cable.
b. Test individual fibers in each cable before shipping to verify compliance with Specifications.

B. Connectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AT&T.
b. Corning Cable Systems.
c. Times Fiber Communications, Inc.

2. Performance Requirements:

a. Type: Fiber-optic connectors shall be either Type ST or Type SMA. Use either connector type exclusively. No substitutions are allowed.

b. Insertion Loss: Connector shall have an insertion loss of not greater than 1 dB.
c. Coupling Tolerance: Connector shall withstand at least 500 couplings with insertion loss within 0.25-dB tolerance limit.
d. Mechanical Requirements:

1) Connector shall enclose outermost coating of single fiber cable and be able to be mated or unmated without using a tool.
2) Mount connector rigidly in a metal frame.
3) Connector shall allow a semiskilled person to properly install connector to a single fiber easily in a field environment with simple tools.

C. Splice Organizer Cabinet:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M.
b. ADC.
c. AMP NETCONNECT; a TE Connectivity Ltd. company.
d. Communications Specialties, Inc.
e. Corning Cable Systems.
f. Liteway, Inc.

2. Minimum Capacity: Each splice organizer shall accommodate number of connectors required for DDC system indicated, plus 100 percent spare.
3. Mounting: Wall mount the splice organizer cabinet.

D. Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anixter Inc.
b. Condux International, Inc.
c. Dura-Line.
d. Pacific Plastics Inc.

2. Mechanical and Performance Requirements:

a. Construction: Nonmetallic, flexible raceway system manufactured specifically for routing fiber-optic cables.
b. Suitable for use in return-air plenums, air-handling rooms, above ceilings and under access floors.
c. Exhibit low smoke generation and flame-spread characteristics, and have high-temperature service tolerance.
d. Size raceway according to NFPA 70 requirements for communications cables.
e. Tensile Strength at Yield: 10,800 psi.
f. Elongation at Break: 25 percent.

E. Cable Identification:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Paul Mueller Company.

2. Labeling product shall be self-laminating cable marker.
3. Cable labeling shall include numeric designation, source, destination, and cable type.

2.30 ACCESSORIES

A. Pneumatic Pressure Gages:

1. Pressure gages shall a 1.5-inch- (38-mm-) diameter face for pressures up through 30 psig (207 kPa) and 2.5-inch- (65-mm-) diameter face for greater pressures.
2. Include separate gages for branch pressure and main pressure lines.
3. White dial face with black printing.
4. Include 1-psig (6.9-kPa) increment for scale ranges through 30 psig (207 kPa) and 2-psig (13.8-kPa) increment for larger ranges.
5. Accuracy: Within 1 percent of full-scale range.

B. Pressure Electric Switches:

1. Diaphragm-operated snap acting switch.
2. Set point adjustable from 3 to 20 psig (21 to 138 kPa).
3. Differential adjustable from 2 to 6 psig (14 to 41 kPa).
4. Rated for resistance loads at 120-V ac.
5. Body and switch housing shall be metal.

C. Damper Blade Limit Switches:

1. Sense positive open and/or closed position of the damper blades.
2. NEMA 250, Type 13, oil-tight construction.
3. Arrange for the mounting application.
4. Additional waterproof enclosure when required by its environment.
5. Arrange to prevent "over-center" operation.

D. I/P and E/P Transducers:

1. Commercial Grade:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) MAMAC Systems, Inc.

b. The transducer shall convert an AO signal to a stepped pneumatic signal. Unless otherwise required by the operating sequence, use a 3- to 15-psig (21- to 103-kPa) pneumatic signal for pneumatic actuation.
c. Construct the entire assembly so that shock and vibration will neither harm the transducer nor affect its accuracy.
d. Transducer shall have auto/manual output switch, manual output control and an output pressure gage.
e. Accuracy: Within 1.0 percent of the output span.
f. Linearity: Within 0.5 percent of the output span.
g. Output Capacity: Not less than 550 scim at 15 psig (103 kPa).
h. Transducer shall have separate zero and span calibration adjustments.

i. The transducer shall withstand up to 40 psig (276 kPa) of supply pressure without damage.
j. For use on only modulating pneumatic outputs that are associated with terminal units, including fan-coil units, VAV units, unit heaters and.

2. Industrial Grade:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Fisher Valves & Instruments; Emerson Process Management.

b. The transducer shall convert an AO signal to a proportional pneumatic signal. Unless otherwise required by the operating sequence, use a 3- to 15-psig (21- to 103-kPa) pneumatic signal for pneumatic actuation. A stepped pneumatic signal is unacceptable.
c. Construct the entire assembly so that shock and vibration will neither harm the transducer nor affect its accuracy.
d. Suitable for operation in an ambient temperature range of minus 40 to 150 deg F (minus 40 to 66 deg C).
e. Accuracy: Within 0.5 percent of the output span.
f. Linearity: Within 0.5 percent of the output span.
g. Output Capacity: Not less than 5 scfm.
h. Transducer shall have zero and span calibration adjustments.
i. The transducer shall withstand up to 50 psig (345 kPa) of supply pressure without damage.
j. For use on all modulating pneumatic outputs, not requiring a commercial-grade transducer.

E. E/P Switch:

1. Construct the body of cast aluminum or brass; three pipe body (common, normally open, and normally closed).
2. Internal construction of steel, copper or brass.
3. Air Connections: Barb.
4. Rating of 30 psig (207 kPa) when installed in systems below 25 psig (172 kPa) and of 150 psig (1034 kPa) when installed in systems above 25 psig (172 kPa).
5. Include coil transient suppression.

F. Instrument Enclosures:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Hoffman; a brand of nVent.

2. Include instrument enclosure for secondary protection to comply with requirements indicated in "Performance Requirements" Article.
3. NRTL listed and labeled to UL 50.
4. Sized to include at least 25 percent spare area on subpanel.
5. Instrument(s) mounted within enclosure on internal subpanel(s).
6. Enclosure face with engraved, laminated phenolic nameplate for each instrument within enclosure.

7. Enclosures housing pneumatic instruments shall include main pressure gage and a branch pressure gage for each pneumatic device, installed inside.
8. Enclosures housing multiple instruments shall route tubing and wiring within enclosure in a raceway having a continuous removable cover.
9. Enclosures larger than 12 inches (300 mm) shall have a hinged full-size face cover.
10. Equip enclosure with lock and common key.

G. Manual Valves:

1. Needle Type:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Parker Hannifin Corporation.

b. PTFE packing.
c. Construct of brass for use with copper and polyethylene tubing and of stainless steel for use with stainless-steel tubing.
d. Aluminum T-bar handle.
e. Include tubing connections.

2. Ball Type:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) NIBCO INC.

b. Body: Bronze ASTM B 62 or ASTM B 61.
c. Ball: Type 316 stainless steel.
d. Stem: Type 316 stainless steel.
e. Seats: Reinforced PTFE.
f. Packing Ring: Reinforced PTFE.
g. Lever: Stainless steel with a vinyl grip.
h. 600 WOG.
i. Threaded end connections.

H. Wall-Mounted Portable Operator's Workstation Cabinet:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Lowell Manufacturing Co.

2. Surface-mounted wall cabinet for tilt-out operation of laptop computers and PDAs.
3. Cabinet shall have a load limit of 50 lb (23 kg).
4. Cabinet shall include the following:

a. Oil-filled dampers for controlled lowering of equipment to operational position.
b. 3RU EIA mounting rails.
c. Removable laptop shelf.

d. Separate top compartment with mounting area, hinged rail and security lock.
e. Front ventilation slots.
f. Knockouts for conduit connections on top and bottom of cabinet.

5. Cabinet shall be constructed of steel and painted with a powder-coat epoxy.
6. Inside center of backbox shall have provision to mount a field-furnished and -installed, single gang electrical outlet box.

2.31 IDENTIFICATION

A. Instrument Air Pipe and Tubing:

1. Engraved tag shall bear the following information:

a. Service (Example): "Instrument Air."
b. Pressure Range (Example): 0 to 30 psig (0 to 200 kPa).

2. Letter size shall be a minimum of 0.25 inch (6 mm) high.
3. Tag shall consist of white lettering on blue background.
4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded blue with contrasting white center exposed by engraving through outer layer.
5. Include tag with a brass grommet, chain and S-hook.

B. Control Equipment, Instruments, and Control Devices:

1. Engraved tag bearing unique identification.

a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.

2. Letter size shall be as follows:

a. Operator Workstations: Minimum of 0.5 inch (13 mm) high.
b. Servers: Minimum of 0.5 inch (13 mm) high.
c. Printers: Minimum of 0.5 inch (13 mm) high.
d. DDC Controllers: Minimum of 0.5 inch (13 mm) high.
e. Gateways: Minimum of 0.5 inch (13 mm) high.
f. Repeaters: Minimum of 0.5 inch (13 mm) high.
g. Enclosures: Minimum of 0.5 inch (13 mm) high.
h. Electrical Power Devices: Minimum of 0.25 inch (6 mm) high.
i. UPS units: Minimum of 0.5 inch (13 mm) high.
j. Accessories: Minimum of 0.25 inch (6 mm) high.
k. Instruments: Minimum of 0.25 inch (6 mm) high.
l. Control Damper and Valve Actuators: Minimum of 0.25 inch (6 mm) high.

3. Tag shall consist of white lettering on black background.
4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded black with contrasting white center exposed by engraving through outer layer.
5. Tag shall be fastened with drive pins.
6. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

C. Valve Tags:

1. Brass tags and brass chains attached to valve.
2. Tags shall be at least 1.5 inches (38 mm) in diameter.
3. Include tag with unique valve identification indicating control influence such as flow, level, pressure, or temperature; followed by location of valve, and followed by three-digit sequential number. For example: TV-1.001.
4. Valves with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

D. Raceway and Boxes:

1. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls," using an engraved phenolic tag.

E. Equipment Warning Labels:

1. Acrylic label with pressure-sensitive adhesive back and peel-off protective jacket.
2. Lettering size shall be at least 14-point type with white lettering on red background.
3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inch (6 mm)beyond white border.

2.32 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate the following according to industry standards for each product, and to verify DDC system reliability specified in performance requirements:

1. DDC controllers.
2. Gateways.
3. Routers.
4. Operator workstations.

B. Product(s) and material(s) will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for products to verify actual locations of connections before installation.

1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

A. Communication Interface to Equipment with Integral Controls:

1. DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control.
2. Equipment to Be Connected:

a. Domestic water booster pumps specified in Section 221123.13 "Domestic-Water Packaged Booster Pumps."
b. Air-terminal units specified in Section 233600 "Air Terminal Units."
c. Kitchen hoods specified in Section 233813 "Commercial-Kitchen Hoods."
d. Boilers specified in Section 235213 "Electric Boilers."
e. Boilers specified in Section 235216 "Condensing Boilers."
f. Boilers specified in Section 235223 "Cast-Iron Boilers."
g. Boilers specified in Section 235233 "Water-Tube Boilers."
h. Boilers specified in Section 235239 "Fire-Tube Boilers."
i. Feedwater equipment specified in Section 235313 "Boiler Feedwater Pumps."
j. Deaerators specified in Section 235316 "Deaerators."
k. Chillers specified in Section 236413.13 "Direct-Fired Absorption Water Chillers."
l. Chillers specified in Section 236413.16 "Indirect-Fired Absorption Water Chillers."
m. Chillers specified in Section 236416 "Centrifugal Water Chillers."
n. Chillers specified in Section 236423.11 "Water-Cooled, Scroll Water Chillers."
o. Chillers specified in Section 236423.21 "Air-Cooled, Scroll Water Chillers."
p. Chillers specified in Section 236426.11 "Water-Cooled, Rotary-Screw Water Chillers."
q. Chillers specified in Section 236426.21 "Air-Cooled, Rotary-Screw Water Chillers."
r. Cooling towers specified in Section 236500 "Cooling Towers."
s. Heat wheels and heat exchangers specified in Section 237200 "Air-to-Air Energy Recovery Equipment."
t. Air-handling units specified in Section 237313 "Modular Indoor Central-Station Air-Handling Units."
u. Roof-top units specified in Section 237413 "Packaged, Outdoor, Central-Station Air-Handling Units."
v. Dedicated outdoor-air units specified in Section 237433 "Dedicated Outdoor-Air Units."
w. Packaged terminal air-conditioners specified in Section 238113.11 "Packaged Terminal Air-Conditioners, Through-Wall Units," Section 238113.12 "Packaged Terminal Air-Conditioners, Freestanding Units," and Section 238113.13 "Packaged Terminal Air-Conditioners, outdoor, wall-mounted units."

x. Computer-room air-conditioning units specified in Section 238123.11 "Computer-Room Air Conditioners, Floor-Mounted Units (6 Tons (21 kW) And Smaller)," Section 238123.12 "Computer-Room Air Conditioners, Floor-Mounted Units (7 Tons (25 kW) And Larger)," Section 238123.13 "Computer-Room Air Conditioners, Ceiling-Mounted Units," Section 238123.14 "Computer-Room Air Conditioners, Console Units," Section 238123.18 "Computer-Room, Rack-Cooling Equipment."
y. Fan-coil units specified in Section 238219 "Fan Coil Units."
z. Unit ventilators specified in Section 238223 "Unit Ventilators."
aa. Humidifiers specified in Section 238413 "Humidifiers."
bb. Dehumification units specified in Section 238416 "Mechanical Dehumidification Units."
cc. Switchboards specified in Section 262300 "Low-Voltage Switchgear."
dd. Motor-control centers specified in Section 262419 "Motor-Control Centers."
ee. Variable-frequency controllers specified in Section 262923 "Variable-Frequency Motor Controllers."
ff. Generator sets specified in Section 263213 "Engine Generators."
gg. UPS specified in Section 263353 "Static Uninterruptible Power Supply."
hh. Refrigerant monitoring.

3.3 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS

A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.

B. Deliver the following to duct fabricator and Installer for installation in ductwork. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. DDC control dampers, which are specified in Section 230923.12 "DDC Control Dampers."
2. Airflow sensors and switches, which are specified in Section 230923.14 "Flow Instruments."
3. Pressure sensors, which are specified in Section 230923.23 "Pressure Instruments."

C. Deliver the following to plumbing and HVAC piping installers for installation in piping. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. DDC control valves, which are specified in Section 230923.11 "Control Valves."
2. Pipe-mounted flow meters, which are specified in Section 230923.14 "Flow Instruments."
3. Pipe-mounted sensors, switches and transmitters. Flow meters are specified in Section 230923.14 "Flow Instruments." Liquid temperature sensors, switches, and transmitters are specified in Section 230923.27 "Temperature Instruments."
4. Tank-mounted sensors, switches and transmitters. Pressure sensors, switches, and transmitters are specified in Section 230923.23 "Pressure Instruments." Liquid temperature sensors, switches, and transmitters are specified in Section 230923.27 "Temperature Instruments."
5. Pipe- and tank-mounted thermowells. Liquid thermowells are specified in Section 230923.27 "Temperature Instruments."

3.4 CONTROL DEVICES FOR EQUIPMENT MANUFACTURER FACTORY INSTALLATION

A. Deliver the following to air-handling unit manufacturer for factory installation. Include installation instructions to air-handling unit manufacturer and supervise installation for compliance with requirements.

1. Programmable application or application-specific controller.
2. Unit-mounted DDC control dampers and actuators, which are specified in Section 230923.12 "Control Dampers."
3. Unit-mounted airflow sensors, switches and transmitters, which are specified in Section 230923.14 "Flow Instruments."
4. Unit-mounted gas sensors and transmitters, which are specified in Section 230923.16 "Gas Instruments."
5. Unit-mounted leak-detection switches, which are specified in Section 230923.18 "Leak-Detection Instruments."
6. Unit-mounted speed sensors, switches and transmitters, which are specified in Section 230923.24 "DDC Speed Instruments."
7. Unit-mounted pressure sensors, switches and transmitters, which are specified in Section 230923.23 "Pressure Instruments."
8. Unit-mounted temperature sensors, switches and transmitters. Air-temperature sensors, switches, and transmitters are specified in Section 230923.27 "Temperature Instruments."
9. Relays.

B. Deliver the following to terminal unit manufacturer for factory installation. Include installation instructions to terminal unit manufacturer.

1. Programmable application or application-specific controller.
2. Electric damper actuator. Dampers actuators are specified in Section 230923.12 "Control Dampers."
3. Unit-mounted flow and pressure sensors, transmitters and transducers. Flow sensors, transmitters, and transducers are specified in Section 230923.14 "Flow Instruments." Pressure sensors, switches, and transmitters are specified in Section 230923.23 "Pressure Instruments."
4. Unit-mounted temperature sensors. Air-temperature sensors, switches, and transmitters are specified in Section 230923.27 "Temperature Instruments."
5. Relays.

C. Deliver the following to fan-coil unit manufacturer for factory installation. Include installation instructions to fan-coil unit manufacturer.

1. Programmable application or application-specific controller.
2. Unit-mounted temperature sensors. Air-temperature sensors, switches, and transmitters are specified in Section 230923.27 "Temperature Instruments."
3. Flow and pressure switches. Air and liquid flow sensors, transmitters, and transducers are specified in Section 230923.14 "Flow Instruments." Pressure sensors, switches, and transmitters are specified in Section 230923.23 "Pressure Instruments."
4. Leak-detection switches, which are specified in Section 230923.18 "Leak-Detection Instruments."
5. Relays.

3.5 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment when subjected to a excessive force.

D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Firestop penetrations made in fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 079200 "Joint Sealants."

H. Welding Requirements:

1. Restrict welding and burning to supports and bracing.
2. No equipment shall be cut or welded without approval. Welding or cutting will not be approved if there is risk of damage to adjacent Work.
3. Welding, where approved, shall be by inert-gas electric arc process and shall be performed by qualified welders according to applicable welding codes.
4. If requested on-site, show satisfactory evidence of welder certificates indicating ability to perform welding work intended.

I. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

J. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

K. Corrosive Environments:

1. Avoid or limit use of materials in corrosive airstreams and environments, including, but not limited to, the following:

    a. Laboratory exhaust-air streams.
    b. Process exhaust-air streams.

2. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

3. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.6 OPERATOR WORKSTATION INSTALLATION

A. Desktop Operator Workstations Installation:

1. Install operator workstation(s) at location(s) directed by Owner.
2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single duplex electrical power receptacle.
3. Install software on workstation(s) and verify software functions properly.
4. Develop Project-specific graphics, trends, reports, logs and historical database.
5. Power each workstation through a dedicated UPS unit. Locate UPS adjacent to workstation.

B. Portable Operator Workstations Installation:

1. Turn over portable operator workstations to Owner at Substantial Completion.
2. Install software on workstation(s) and verify software functions properly.

C. Color Graphics Application:

1. Use system schematics indicated as starting point to create graphics.
2. Develop Project-specific library of symbols for representing system equipment and products.
3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
4. Submit sketch of graphic layout with description of all text for each graphic for Owner's[**and Architect's**] review before creating graphic using graphics software.
5. Seek Owner input in graphics development once using graphics software.
6. Final editing shall be done on-site with Owner's and Architect's review and feedback.
7. Refine graphics as necessary for Owner acceptance.
8. On receiving Owner acceptance, print a hard copy for inclusion in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of DDC system operation and maintenance manual.

3.7 GATEWAY INSTALLATION

A. Install gateways if required for DDC system communication interface requirements indicated.

B. Test gateway to verify that communication interface functions properly.

3.8 ROUTER INSTALLATION

A. Install routers if required for DDC system communication interface requirements indicated.

B. Test router to verify that communication interface functions properly.

3.9 CONTROLLER INSTALLATION

A. Install controllers in enclosures to comply with indicated requirements.

B. Connect controllers to field power supply and to UPS units where indicated.

C. Install controller with latest version of applicable software and configure to execute requirements indicated.

D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

E. Installation of Network Controllers:

1. Quantity and location of network controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. Install controllers in a protected location that is easily accessible by operators.
3. Top of controller shall be within 72 inches (1800 mm) of finished floor.

F. Installation of Programmable Application Controllers:

1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. Install controllers in a protected location that is easily accessible by operators.
3. Top of controller shall be within 72 inches (1800 mm) of finished floor.

G. Application-Specific Controllers:

1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

3.10 ENCLOSURES INSTALLATION

A. Install the following items in enclosures, to comply with indicated requirements:

1. Gateways.
2. Routers.
3. Controllers.
4. Electrical power devices.
5. UPS units.
6. Relays.
7. Accessories.
8. Instruments.
9. Actuators

B. Attach wall-mounted enclosures to wall using the following types of steel struts:

1. For NEMA 250, Type 1 Enclosures: Use painted steel strut and hardware.
2. For NEMA 250, Type 4X Enclosures and Enclosures Located Outdoors: Use stainless-steel strut and hardware.
3. Install plastic caps on exposed cut edges of strut.

C. Align top of adjacent enclosures of like size.

3.11 ELECTRIC POWER CONNECTIONS

A. Connect electrical power to DDC system products requiring electrical power connections.

B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with NFPA 70 and other requirements indicated.

C. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.

D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.

E. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

3.12 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification products and installation.

B. Install engraved phenolic nameplate with unique identification on face for each of the following:

1. Operator workstation.
2. Server.
3. Printer.
4. Gateway.
5. Router.
6. Protocol analyzer.
7. DDC controller.
8. Enclosure.
9. Electrical power device.
10. UPS unit.
11. Accessory.

C. Install engraved phenolic nameplate with unique instrument identification on face of each instrument connected to a DDC controller.

D. Install engraved phenolic nameplate with identification on face of each control damper and valve actuator connected to a DDC controller.

E. Where product is installed above accessible tile ceiling, also install matching engraved phenolic nameplate with identification on face of ceiling grid located directly below.

F. Where product is installed above an inaccessible ceiling, also install engraved phenolic nameplate with identification on face of access door directly below.

G. Warning Labels:

1. Shall be permanently attached to equipment that can be automatically started by DDC control system.
2. Shall be located in highly visible location near power service entry points.

3.13 NETWORK INSTALLATION

A. Install fiber-optic cable when connecting between the following network devices and when located in different buildings on campus, or when distance between devices exceeds 300 feet:

1. Operator workstations.
2. Operator workstations and network controllers.
3. Network controllers.

B. Install network cable in continuous raceway.

1. Where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

3.14 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

B. ASHRAE 135 Networks:

1. MAC Address:

a. Every network device shall have an assigned and documented MAC address unique to its network.
b. Ethernet Networks: Document MAC address assigned at its creation.
c. ARCNET or MS/TP networks: Assign from 00 to 64.

2. Network Numbering:

a. Assign unique numbers to each new network.
b. Provide ability for changing network number through device switches or operator interface.
c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.

3. Device Object Identifier Property Number:

a. Assign unique device object identifier property numbers or device instances for each device network.
b. Provide for future modification of device instance number by device switches or operator interface.
c. LAN shall support up to 4,194,302 unique devices.

4. Device Object Name Property Text:

a. Device object name property field shall support 32 minimum printable characters.
b. Assign unique device "Object Name" property names with plain-English descriptive names for each device.

1) Example 1: Device object name for device controlling boiler plant at Building 1000 would be "HW System B1000."
2) Example 2: Device object name for a VAV terminal unit controller could be "VAV unit 102".

5. Object Name Property Text for Other Than Device Objects:

a. Object name property field shall support 32 minimum printable characters.
b. Assign object name properties with plain-English names descriptive of application.

1) Example 1: "Zone 1 Temperature."
2) Example 2 "Fan Start and Stop."

6. Object Identifier Property Number for Other Than Device Objects:

a. Assign object identifier property numbers according to Drawings or tables indicated.
b. If not indicated, object identifier property numbers may be assigned at Installer's discretion but must be approved by Owner in advance, be documented and be unique for like object types within device.

3.15 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NECA 1.

B. Comply with TIA 568-C.1.

C. Wiring Method: Install cables in raceways and cable trays except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

E. Field Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

F. Conduit Installation:

1. Install conduit expansion joints where conduit runs exceed 200 feet (60 m), and conduit crosses building expansion joints.
2. Coordinate conduit routing with other trades to avoid conflicts with ducts, pipes and equipment and service clearance.
3. Maintain at least 3-inch (75-mm) separation where conduits run axially above or below ducts and pipes.
4. Limit above-grade conduit runs to 100 feet (30 m) without pull or junction box.

5. Do not install raceways or electrical items on any "explosion-relief" walls, or rotating equipment.
6. Do not fasten conduits onto the bottom side of a metal deck roof.
7. Flexible conduit is permitted only where flexibility and vibration control is required.
8. Limit flexible conduit to 3 feet (1 m) long.
9. Conduit shall be continuous from outlet to outlet, from outlet to enclosures, pull and junction boxes, and shall be secured to boxes in such manner that each system shall be electrically continuous throughout.
10. Direct bury conduits underground or install in concrete-encased duct bank where indicated.

    a. Use rigid, nonmetallic, Schedule 80 PVC.
    b. Provide a burial depth according to NFPA 70, but not less than 24 inches (600 mm).

11. Secure threaded conduit entering an instrument enclosure, cabinet, box, and trough, with a locknut on outside and inside, such that conduit system is electrically continuous throughout. Provide a metal bushing on inside with insulated throats. Locknuts shall be the type designed to bite into the metal or, on inside of enclosure, shall have a grounding wedge lug under locknut.
12. Conduit box-type connectors for conduit entering enclosures shall have an insulated throat.
13. Connect conduit entering enclosures in wet locations with box-type connectors or with watertight sealing locknuts or other fittings.
14. Offset conduits where entering surface-mounted equipment.
15. Seal conduit runs used by sealing fittings to prevent the circulation of air for the following:

    a. Conduit extending from interior to exterior of building.
    b. Conduit extending into pressurized duct and equipment.
    c. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.

G. Wire and Cable Installation:

1. Cables serving a common system may be grouped in a common raceway. Install control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
2. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.

    a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.

3. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
5. UTP Cable Installation:

    a. Comply with TIA 568-C.2.
    b. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination, to maintain cable geometry.

6. Installation of Cable Routed Exposed under Raised Floors:

    a. Install plenum-rated cable only.
    b. Install cabling after the flooring system has been installed in raised floor areas.
    c. Coil cable 6 feet (1.8 m) long not less than 12 inches (300 mm) in diameter below each feed point.

7. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.
8. Provide strain relief.
9. Terminate wiring in a junction box.

    a. Clamp cable over jacket in junction box.
    b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.

10. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
11. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
12. Keep runs short. Allow extra length for connecting to terminal boards. Do not bend flexible coaxial cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
13. Ground wire shall be copper and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.
14. Wire and cable shall be continuous from terminal to terminal without splices.
15. Use insulated spade lugs for wire and cable connection to screw terminals.
16. Use shielded cable to transmitters.
17. Use shielded cable to temperature sensors.
18. Perform continuity and meager testing on wire and cable after installation.
19. Do not install bruised, kinked, scored, deformed, or abraded wire and cable. Remove and discard wire and cable if damaged during installation, and replace it with new cable.
20. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
21. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
22. Protection from Electro-Magnetic Interference (EMI): Provide installation free of (EMI). As a minimum, comply with the following requirements:

    a. Comply with BICSI TDMM and TIA 569-C for separating unshielded cable from potential EMI sources, including electrical power lines and equipment.
    b. Separation between open cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

        1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
        2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
        3) Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

    c. Separation between cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
3) Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

d. Separation between cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

1) Electrical Equipment Rating Less Than 2 kVA: No requirement.
2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
3) Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

e. Separation between Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches (1200 mm).
f. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.16 FIBER-OPTIC CABLE SYSTEM INSTALLATION

A. Comply with TIA 568-C.3, except where requirements indicated are more stringent.

B. Raceway Installation:

1. Install continuous raceway for routing fiber-optic cables.
2. Install raceways continuously between pull boxes and junction boxes. Raceways shall enter and be secured to enclosures.
3. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
4. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Use long radius elbows for all fiber-optic cables.
5. Entire raceway shall be complete and raceway interior cleaned before installation of fiber-optic cables.
6. Securely fasten raceway to building structure using clamps and clips designed for purpose.
7. Install nylon or polyethylene pulling line in raceways. Clearly label as "pulling line," indicating source and destination.

C. Fiber-Optic Cable Installation:

1. Route cables as efficiently as possible, minimizing amount of cable required.
2. Continuously lubricate cables during pulling-in process.
3. Do not exceed maximum pulling tensions provided by cable manufacturer. Monitor cable pulling tension with a mechanical tension meter.
4. Arrange cables passing through pull boxes to obtain maximum clearance among cables within box.
5. As cables emerge from intermediate point pull boxes, coil cable in a figure eight pattern with loops not less than 24 inches (600 mm) in diameter.

6. Terminate fiber-optic cables in a fiber-optic splice organizer cabinet, unless connected equipment can accept fiber-optic cables directly. Terminate cables with connectors.
7. Install and connect appropriate opto-electronic equipment and fiber jumper cables between opto-electronic equipment and fiber-optic cable system to DDC system fiber-optic cable system. Verify interface compatibility.

D. Cable and Raceway Identification:

1. Label cables at both ends. Labels shall be typed, not handwritten.
2. Mark raceways at each pull box indicating the type and number of cables within.

3.17 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Testing of Pneumatic and Air-Signal Tubing:

a. Test for leaks and obstructions.
b. Disconnect each pipe and tubing line before a test is performed, and blowout dust, dirt, trash, condensate and other foreign materials with compressed air. Use commercially pure compressed air or nitrogen as distributed in gas cylinders. Air from an oil-free compressor with an air dryer is an acceptable alternative for the test.
c. After foreign matter is expelled and line is free from obstructions, plug far end of tubing run.
d. Connect a pressure source to near end of run with a needle valve between air supply and tubing run.
e. Connect a pressure gage accurate to within 0.5 percent of test between the shutoff needle valve and tubing run under test.
f. For system pressures above 30 psig (207 kPa), apply a pressure of 1.5 times operating pressure. Record pressure in tubing run every 10 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 1 psig (6.9 kPa).
g. For system pressures 30 psig (207 kPa) and below, apply a pressure of 2.0 times operating pressure to piping and tubing run. Record pressure in tubing run every 5 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 0.5 psig (3.5 kPa).

D. Testing:

1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.
2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification

documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.

3. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.
4. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.
5. Test Equipment: Use a fiber-optic time domain reflectometer for testing of length and optical connectivity.
6. Test Results: Record test results and submit copy of test results for Project record.

3.18 DDC SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.

E. For pneumatic products, verify that air supply for each product is properly installed.

F. Control Damper Checkout:

1. For pneumatic dampers, verify that pressure gages are provided in each air line to damper actuator and positioner.
2. Verify that control dampers are installed correctly for flow direction.
3. Verify that proper blade alignment, either parallel or opposed, has been provided.
4. Verify that damper frame attachment is properly secured and sealed.
5. Verify that damper actuator and linkage attachment is secure.
6. Verify that actuator wiring is complete, enclosed and connected to correct power source.
7. Verify that damper blade travel is unobstructed.

G. Control Valve Checkout:

1. For pneumatic valves, verify that pressure gages are provided in each air line to valve actuator and positioner.
2. Verify that control valves are installed correctly for flow direction.
3. Verify that valve body attachment is properly secured and sealed.
4. Verify that valve actuator and linkage attachment is secure.
5. Verify that actuator wiring is complete, enclosed and connected to corect power source.
6. Verify that valve ball, disc or plug travel is unobstructed.
7. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

H. Instrument Checkout:

1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
2. Verify that attachment is properly secured and sealed.
3. Verify that conduit connections are properly secured and sealed.
4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments:

    a. Verify sensing element type and proper material.
    b. Verify length and insertion.

3.19 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:

A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.

C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.

D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.

E. Provide diagnostic and test equipment for calibration and adjustment.

F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.

G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.

H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.

I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

J. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.

3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

K. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact making or breaking.

L. Control Dampers:

1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

M. Control Valves:

1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

N. Meters: Check sensors at zero, 50, and 100 percent of Project design values.

O. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

P. Switches: Calibrate switches to make or break contact at set points indicated.

Q. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

3.20 DDC SYSTEM CONTROLLER CHECKOUT

A. Verify power supply.

1. Verify voltage, phase and hertz.
2. Verify that protection from power surges is installed and functioning.
3. Verify that ground fault protection is installed.
4. If applicable, verify if connected to UPS unit.
5. If applicable, verify if connected to a backup power source.

6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.

B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.

C. Verify that spare I/O capacity is provided.

3.21 DDC CONTROLLER I/O CONTOL LOOP TESTS

A. Testing:

1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
2. Test every I/O point throughout its full operating range.
3. Test every control loop to verify operation is stable and accurate.
4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
5. Test and adjust every control loop for proper operation according to sequence of operation.
6. Test software and hardware interlocks for proper operation. Correct deficiencies.
7. Operate each analog point at the following:

    a. Upper quarter of range.
    b. Lower quarter of range.
    c. At midpoint of range.

8. Exercise each binary point.
9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.
10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

3.22 DDC SYSTEM VALIDATION TESTS

A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.

B. After approval of Test Plan, execute all tests and procedures indicated in plan.

C. After testing is complete, submit completed test checklist.

D. Pretest Checklist: Submit the following list with items checked off once verified:

1. Detailed explanation for any items that are not completed or verified.
2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
3. HVAC equipment motors operate below full-load amperage ratings.
4. Required DDC system components, wiring, and accessories are installed.

5. Installed DDC system architecture matches approved Drawings.
6. Control electric power circuits operate at proper voltage and are free from faults.
7. Required surge protection is installed.
8. DDC system network communications function properly, including uploading and downloading programming changes.
9. Using BACnet protocol analyzer, verify that communications are error free.
10. Each controller's programming is backed up.
11. Equipment, products, tubing, wiring cable and conduits are properly labeled.
12. All I/O points are programmed into controllers.
13. Testing, adjusting and balancing work affecting controls is complete.
14. Dampers and actuators zero and span adjustments are set properly.
15. Each control damper and actuator goes to failed position on loss of power.
16. Valves and actuators zero and span adjustments are set properly.
17. Each control valve and actuator goes to failed position on loss of power.
18. Meter, sensor and transmitter readings are accurate and calibrated.
19. Control loops are tuned for smooth and stable operation.
20. View trend data where applicable.
21. Each controller works properly in standalone mode.
22. Safety controls and devices function properly.
23. Interfaces with fire-alarm system function properly.
24. Electrical interlocks function properly.
25. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
26. Record Drawings are completed.

E. Test Plan:

1. Prepare and submit a validation test plan including test procedures for performance validation tests.
2. Test plan shall address all specified functions of DDC system and sequences of operation.
3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
5. Include a test checklist to be used to check and initial that each test has been successfully completed.
6. Submit test plan documentation 20 business days before start of tests.

F. Validation Test:

1. Verify operating performance of each I/O point in DDC system.

    a. Verify analog I/O points at operating value.
    b. Make adjustments to out-of-tolerance I/O points.

        1) Identify I/O points for future reference.
        2) Simulate abnormal conditions to demonstrate proper function of safety devices.
        3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.

2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
4. After 24 Hours following Initial Validation Test:

a. Re-check I/O points that required corrections during initial test.
b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.

5. After 24 Hours of Second Validation Test:

a. Re-check I/O points that required corrections during second test.
b. Continue validation testing until I/O point is normal on two consecutive tests.

6. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.
7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

G. DDC System Response Time Test:

1. Simulate HLC.

a. Heavy load shall be an occurrence of 50 percent of total connected binary COV, one-half of which represent an "alarm" condition, and 50 percent of total connected analog COV, one-half of which represent an "alarm" condition, that are initiated simultaneously on a one-time basis.

2. Initiate 10 successive occurrences of HLC and measure response time to typical alarms and status changes.
3. Measure with a timer having at least 0.1-second resolution and 0.01 percent accuracy.
4. Purpose of test is to demonstrate DDC system, as follows:

a. Reaction to COV and alarm conditions during HLC.
b. Ability to update DDC system database during HLC.

5. Passing test is contingent on the following:

a. Alarm reporting at printer beginning no more than two seconds after the initiation (time zero) of HLC.
b. All alarms, both binary and analog, are reported and printed; none are lost.
c. Compliance with response times specified.

6. Prepare and submit a report documenting HLC tested and results of test including time stamp and print out of all alarms.

H. DDC System Network Bandwidth Test:

1. Test network bandwidth usage on all DDC system networks to demonstrate bandwidth usage under DDC system normal operating conditions and under simulated HLC.
2. To pass, none of DDC system networks shall use more than 70 percent of available bandwidth under normal and HLC operation.

3.23 DDC SYSTEM WIRELESS NETWORK VERIFICATION

A. DDC system Installer shall design wireless DDC system networks to comply with performance requirements indicated.

B. Installer shall verify wireless network performance through field testing and shall document results in a field test report.

C. Testing and verification of all wireless devices shall include, but not be limited to, the following:

1. Speed.
2. Online status.
3. Signal strength.

3.24 FINAL REVIEW

A. Submit written request to Architect when DDC system is ready for final review. Written request shall state the following:

1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
4. DDC system is complete and ready for final review.

B. Review by Architect shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.

E. Prepare and submit closeout submittals and begin procedures indicated in "Extended Operation Test" Article when no deficiencies are reported.

F. A part of DDC system final review shall include a demonstration to parties participating in final review.

1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.
3. Demonstration shall include, but not be limited to, the following:

a. Accuracy and calibration of 20 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation. Up to 20 I/O points

shall be randomly selected by reviewers. Additional I/O points may be selected by reviewers to discover problems with operation.

c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.
d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.
e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.
f. Trends, summaries, logs and reports set-up for Project.
g. For up to three HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.
h. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.
i. Software's ability to edit control programs off-line.
j. Data entry to show Project-specific customizing capability including parameter changes.
k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
l. Execution of digital and analog commands in graphic mode.
m. Spreadsheet and curve plot software and its integration with database.
n. Online user guide and help functions.
o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.
p. System speed of response compared to requirements indicated.
q. For Each Network and Programmable Application Controller:

    1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.
    2) Operator Interface: Ability to connect directly to each type of digital controller with a portable operator workstation and PDA. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.
    3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.
    4) Electric Power: Ability to disconnect any controller safely from its power source.
    5) Wiring Labels: Match control drawings.
    6) Network Communication: Ability to locate a controller's location on network and communication architecture matches Shop Drawings.
    7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.

r. For Each Operator Workstation:

    1) I/O points lists agree with naming conventions.
    2) Graphics are complete.
    3) UPS unit, if applicable, operates.

s. Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. Use ASHRAE 135 protocol analyzer to help identify

devices, view network traffic, and verify interoperability. Requirements must be met even if only one manufacturer's equipment is installed.

1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.
2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.
3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated. Modifications are made with messages and write services initiated by an operator using workstation graphics, or by completing a field in a menu with instructional text.
4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
5) Alarm and Event Management: Alarms and events are installed and prioritized according to Owner. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.
10) Device and Network Management:

    a) Display of network device status.
    b) Display of BACnet Object Information.
    c) Silencing devices transmitting erroneous data.
    d) Time synchronization.
    e) Remote device re-initialization.
    f) Backup and restore network device programming and master database(s).
    g) Configuration management of routers.

3.25 EXTENDED OPERATION TEST

A. Extended operation test is intended to simulate normal operation of DDC system by Owner.

B. Operate DDC system for an operating period of 14 consecutive calendar days following Substantial Completion. Coordinate exact start date of testing with Owner.

C. Provide an operator familiar with DDC system installed to man an operator workstation while on-site during eight hours of each normal business day occurring during operating period.

D. During operating period, DDC system shall demonstrate correct operation and accuracy of monitored and controlled points as well as operation capabilities of sequences, logs, trends, reports, specialized control algorithms, diagnostics, and other software indicated.

    1. Correct defects of hardware and software when it occurs.

E. Definition of Failures and Downtime during Operating Period:

1. Failed I/O point constituting downtime is an I/O point failing to perform its intended function consistently and a point physically failed due to hardware and software.
2. Downtime is when any I/O point in DDC system is unable to fulfill its' required function.
3. Downtime shall be calculated as elapsed time between a detected point failure as confirmed by an operator and time point is restored to service.
4. Maximum time interval allowed between DDC system detection of failure occurrence and operator confirmation shall be 0.5 hours.
5. Downtime shall be logged in hours to nearest 0.1 hour.
6. Power outages shall not count as downtime, but shall suspend test hours unless systems are provided with UPS and served through a backup power source.
7. Hardware or software failures caused by power outages shall count as downtime.

F. During operating period, log downtime and operational problems are encountered.

1. Identify source of problem.
2. Provide written description of corrective action taken.
3. Record duration of downtime.
4. Maintain log showing the following:

    a. Time of occurrence.
    b. Description of each occurrence and pertinent written comments for reviewer to understand scope and extent of occurrence.
    c. Downtime for each failed I/O point.
    d. Running total of downtime and total time of I/O point after each problem has been restored.

5. Log shall be available to Owner for review at any time.

G. For DDC system to pass extended operation test, total downtime shall not exceed 2 percent of total point-hours during operating period.

1. Failure to comply with minimum requirements of passing at end of operating period indicated shall require that operating period be extended one consecutive day at a time until DDC system passes requirement.

H. Evaluation of DDC system passing test shall be based on the following calculation:

1. Downtime shall be counted on a point-hour basis where total number of DDC system point-hours is equal to total number of I/O points in DDC system multiplied by total number of hours during operating period.
2. One point-hour of downtime is one I/O point down for one hour. Three points down for five hours is a total of 15 point-hours of downtime. Four points down for one-half hour is 2 point-hours of downtime.
3. Example Calculation: Maximum allowable downtime for 30-day test when DDC system has 1000 total I/O points (combined analog and binary) and has passing score of 1 percent downtime is computed by 30 days x 24 h/day x 1000 points x 1 percent equals 7200 point-hours of maximum allowable downtime.

I. Prepare test and inspection reports.

3.26 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.27 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by DDC system manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, cleaning, calibration and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.28 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two year(s).

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two year(s) from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access system and to upgrade computer equipment if necessary.

3.29 DEMONSTRATION

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.

B. Extent of Training:

1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
3. Minimum Training Requirements:

a. Provide not less than five days of training total.
b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
c. Total days of training shall be broken into not more than three separate training classes.
d. Each training class shall be not less than one consecutive day(s).

C. Training Schedule:

1. Schedule training with Owner 20 business days before expected Substantial Completion.

2. Schedule training to provide Owner with at least 10 business days of notice in advance of training.
3. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays, with two morning sessions and two afternoon sessions. Each morning session and afternoon session shall be split in half with 15-minute break between sessions. Morning and afternoon sessions shall be separated by 60-minute lunch period. Training, including breaks and excluding lunch period, shall not exceed eight hours per day.
4. Provide staggered training schedule as requested by Owner.

D. Training Attendee List and Sign-in Sheet:

1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
5. At end of each training day, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

E. Training Attendee Headcount:

1. Plan in advance of training for three attendees.
2. Make allowance for Owner to add up to two attendee(s) at time of training.
3. Headcount may vary depending on training content covered in session. Attendee access may be restricted to some training content for purposes of maintaining system security.

F. Training Attendee Prior Knowledge: For guidance in planning required training and instruction, assume attendees have the following:

1. High school and technical school education and degree.
2. Basic user knowledge of computers and office applications.
3. Basic knowledge of HVAC systems.
4. Basic knowledge of DDC systems.
5. Basic knowledge of DDC system and products installed.

G. Attendee Training Manuals:

1. Provide each attendee with a color hard copy of all training materials and visual presentations.
2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

H. Instructor Requirements:

1. One or multiple qualified instructors, as required, to provide training.

2. Instructors shall have not less than five years of providing instructional training on not less than five past projects with similar DDC system scope and complexity to DDC system installed.

I. Organization of Training Sessions:

1. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate the following three levels of operators:

   a. Daily operators.
   b. Advanced operators.
   c. System managers and administrators.

2. Plan and organize training sessions to group training content to protect DDC system security. Some attendees may be restricted to some training sessions that cover restricted content for purposes of maintaining DDC system security.

J. Training Outline:

1. Submit training outline for Owner review at least 10 business day before scheduling training.
2. Outline shall include a detailed agenda for each training day that is broken down into each of four training sessions that day, training objectives for each training session and synopses for each lesson planned.

K. On-Site Training:

1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
5. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

L. Off-Site Training:

1. Provide conditioned training rooms and workspace with ample tables desks or tables, chairs, power and data connectivity for each attendee.
2. Provide capability to remotely access to Project DDC system for use in training.
3. Provide a workstation for use by each attendee.

M. Training Content for Daily Operators:

1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.

5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.
8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals including control drawings.
11. Understanding physical location and placement of DDC controllers and I/O hardware.
12. Accessing data from DDC controllers.
13. Operating portable operator workstations.
14. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
15. Running each specified report and log.
16. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
17. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
18. Executing digital and analog commands in graphic mode.
19. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
20. Demonstrating DDC system performance through trend logs and command tracing.
21. Demonstrating scan, update, and alarm responsiveness.
22. Demonstrating spreadsheet and curve plot software, and its integration with database.
23. Demonstrating on-line user guide, and help function and mail facility.
24. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
25. Demonstrating the following for HVAC systems and equipment controlled by DDC system:

    a. Operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
    b. For HVAC equipment with factory-installed software, show that integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.
    c. Using graphed trends, show that sequence of operation is executed in correct manner, and HVAC systems operate properly through complete sequence of operation including seasonal change, occupied and unoccupied modes, warm-up and cool-down cycles and other modes of operation indicated.
    d. Hardware interlocks and safeties function properly and DDC system performs correct sequence of operation after electrical power interruption and resumption after power is restored.
    e. Reporting of alarm conditions for each alarm, and confirm that alarms are received at assigned locations, including operator workstations.
    f. Each control loop responds to set point adjustment and stabilizes within time period indicated.
    g. Sharing of previously graphed trends of all control loops to demonstrate that each control loop is stable and set points are being maintained.

N. Training Content for Advanced Operators:

1. Making and changing workstation graphics.
2. Creating, deleting and modifying alarms including annunciation and routing.
3. Creating, deleting and modifying point trend logs including graphing and printing on an ad-hoc basis and operator-defined time intervals.
4. Creating, deleting and modifying reports.

5. Creating, deleting and modifying points.
6. Creating, deleting and modifying programming including ability to edit control programs off-line.
7. Creating, deleting and modifying system graphics and other types of displays.
8. Adding DDC controllers and other network communication devices such as gateways and routers.
9. Adding operator workstations.
10. Performing DDC system checkout and diagnostic procedures.
11. Performing DDC controllers operation and maintenance procedures.
12. Performing operator workstation operation and maintenance procedures.
13. Configuring DDC system hardware including controllers, workstations, communication devices and I/O points.
14. Maintaining, calibrating, troubleshooting, diagnosing and repairing hardware.
15. Adjusting, calibrating and replacing DDC system components.

O. Training Content for System Managers and Administrators:

1. DDC system software maintenance and backups.
2. Uploading, downloading and off-line archiving of all DDC system software and databases.
3. Interface with Project-specific, third-party operator software.
4. Understanding password and security procedures.
5. Adding new operators and making modifications to existing operators.
6. Operator password assignments and modification.
7. Operator authority assignment and modification.
8. Workstation data segregation and modification.

P. Video of Training Sessions:

1. Provide a digital video and audio recording of each training session. Create a separate recording file for each session.
2. Stamp each recording file with training session number, session name and date.
3. Provide Owner with two copies of digital files on DVDs or flash drives for later reference and for use in future training.
4. Owner retains right to make additional copies for intended training purposes without having to pay royalties.

END OF SECTION 23 09 23

SECTION 23 09 23.11

CONTROL VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes control valves and actuators for DDC systems.

B. Related Requirements:

1. Section 23 09 23 "Direct-Digital Control System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 23 09 93 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 230923.11.

1.3 DEFINITIONS

A. Cv: Design valve coefficient.

B. DDC: Direct-digital control.

C. NBR: Nitrile butadiene rubber.

D. PTFE: Polytetrafluoroethylene

E. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.

4. Installation, operation, and maintenance instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include diagrams for pneumatic signal and main air tubing.

C. Delegated-Design Submittal:

1. Schedule and design calculations for control valves and actuators, including the following:

a. Flow at project design and minimum flow conditions.
b. Pressure differential drop across valve at project design flow condition.
c. Maximum system pressure differential drop (pump close-off pressure) across valve at project minimum flow condition.
d. Design and minimum control valve coefficient with corresponding valve position.
e. Maximum close-off pressure.
f. Leakage flow at maximum system pressure differential.
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Control valve installation location shown in relationship to room, duct, pipe, and equipment.
2. Size and location of wall access panels for control valves installed behind walls.
3. Size and location of ceiling access panels for control valves installed above inaccessible ceilings.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to size products where indicated as delegated design.

D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

E. Backup Power Source: Systems and equipment served by a backup power source shall have associated control valve actuators served from a backup power source.

F. Environmental Conditions:

1. Provide electric control valve actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control valve actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.

    a. Hazardous Locations: Explosion-proof rating for condition.

G. Determine control valve sizes and flow coefficients by ISA 75.01.01.

H. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

I. Selection Criteria:

1. Control valves shall be suitable for operation at following conditions:

    a. Chilled Water: 90 PSI at 30 to 50 degrees F.
    b. Condenser Water: 90 PSI at 50 to 110 degrees F.
    c. Heating Hot Water: 90 PSI at 80 to 200 degrees F.

2. Control valve shutoff classifications shall be FCI 70-2, Class IV or better unless otherwise indicated.
3. Valve pattern, three-way or straight through, shall be as indicated on Drawings.
4. Modulating straight-through pattern control valves shall have equal percentage flow-throttling characteristics unless otherwise indicated.
5. Modulating three-way pattern water valves shall have linear flow-throttling characteristics. The total flow through the valve shall remain constant regardless of the valve's position.
6. Modulating butterfly valves shall have linear flow-throttling characteristics.
7. Fail positions unless otherwise indicated:

    a. Chilled Water: Close.
    b. Condenser Water: Close.
    c. Heating Hot Water: Close.

8. Globe-type control valves shall pass the design flow required with not more than 95 percent of stem lift unless otherwise indicated.
9. Rotary-type control valves, such as ball and butterfly valves, shall have Cv falling between 65 and 75 degrees of valve full open position and minimum valve Cv between 15 and 25 percent of open position.
10. Selection shall consider viscosity, flashing, and cavitation corrections.
11. Valves shall have stable operation throughout full range of operation, from design to minimum Cv.

12. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
13. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 7 psig ((48 kPa)) at design flow unless otherwise indicated.
14. Modulating valve sizes for steam service shall provide a pressure drop at design flow equal to lesser of the following:

    a. 50 percent of the valve inlet pressure.
    b. 50 percent of the absolute steam pressure at the valve inlet.

15. Two-position control valves shall be line size unless otherwise indicated.
16. In water systems, use ball- or globe-style control valves for two-position control for valves NPS 2 ((DN 50)) and smaller and butterfly style for valves larger than NPS 2 (DN 50).
17. In steam systems, use ball- or globe-style control valves regardless of size.
18. Pneumatic, two-position control valves shall provide a smooth opening and closing characteristic slow enough to avoid water hammer. Valves with pneumatic actuators shall have an adjustable opening time (valve full closed to full open) and an adjustable closing time (valve full open to full closed) ranging from zero to 10 seconds. Opening and closing times shall be independently adjustable.
19. Control valve, pneumatic-control signal shall not exceed 200 feet (60 m). For longer distances, provide an electric/electronic control signal to the valve and an electric solenoid valve or electro-pneumatic transducer at the valve to convert the control signal to pneumatic.

2.2 BALL-STYLE CONTROL VALVES

A. Pressure-Independent Ball Valves NPS 2 (DN 50) and Smaller:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Belimo Aircontrols (USA), Inc.
    b. HCI; Hydronics Components Inc.
    c. Siemens Industry, Inc., Building Technologies Division.

2. Performance:

    a. Pressure Rating: 600 psig (4137 kPa) for NPS 1 (DN 25) and 400 psig (2528 kPa) for NPS 1-1/2 and NPS 2 (DN 38 and DN 50).
    b. Close-off pressure of 200 psig (1379 kPa).
    c. Process Temperature Range: Between zero to 212 deg F (minus 18 to plus 100 deg C).
    d. Rangeability: 100 to 1.

3. Integral Pressure Regulator: Located upstream of ball to regulate pressure, to maintain a constant pressure differential while operating within a pressure differential range of 5 to 50 psig ((34 to 345 kPa)).
4. Body: Forged brass, nickel plated, and with threaded ends.
5. Ball: Chrome-plated brass.
6. Stem and Stem Extension: Chrome-plated brass, blowout-proof design.
7. Stem sleeve or other approved means to allow valve to be opened and closed without damaging field-applied insulation and insulation vapor barrier seal.
8. Ball Seats: Reinforced PTFE.

9. Stem Seal: Reinforced PTFE packing ring stem seal with threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if equivalent cycle endurance can be achieved.
10. Flow Characteristic: Equal percentage.

2.3 BUTTERFLY-STYLE CONTROL VALVES

A. Commercial-Grade, Two-Way Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Keystone; Emerson Electric Co.
    b. Siemens Industry, Inc., Building Technologies Division.

2. Performance:

    a. Bi-directional bubble tight shutoff at 250 psig (1724 kPa).
    b. Comply with MSS SP-67 or MSS SP-68.
    c. Rotation: Zero to 90 degrees.
    d. Linear or modified equal percentage flow characteristic.

3. Body: Cast iron ASTM A 126, Class B, ductile iron ASTM A 536 or cast steel ASTM A 216/A 216M WCB fully lugged, suitable for mating to ASME B16.5 flanges.
4. Disc: 316 stainless steel.
5. Shaft: 316 or 17-4 PH stainless steel.
6. Seat: Reinforced EPDM or reinforced PTFE with retaining ring.
7. Shaft Bushings: Reinforced PTFE or stainless steel.
8. Replaceable seat, disc, and shaft bushings.
9. Corrosion-resistant nameplate indicating:

    a. Manufacturer's name, model number, and serial number.
    b. Body size.
    c. Body and trim materials.
    d. Flow arrow.

B. Commercial-Grade, Three-Way Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Keystone; Emerson Electric Co.
    b. Siemens Industry, Inc., Building Technologies Division.

2. Arrangement: Two valves mated to a fabricated tee with interconnecting mechanical linkage.
3. Performance:

    a. Bi-directional bubble tight shutoff at 250 psig (1724 kPa).
    b. Comply with MSS SP-67 or MSS SP-68.
    c. Rotation: Zero to 90 degrees.
    d. Linear or modified equal percentage flow characteristic.

4. Body: Cast iron ASTM A 126, Class B, ductile iron ASTM A 536 or cast steel ASTM A 216/A 216M WCB fully lugged, suitable for mating to ASME B16.5 flanges.
5. Disc: 316 stainless steel.
6. Shaft: 316 or 17-4 PH stainless steel.
7. Seat: Reinforced EPDM or reinforced PTFE seat with retaining ring.
8. Shaft Bushings: Reinforced PTFE or stainless steel.
9. Replaceable seat, disc, and shaft bushings.
10. Corrosion-resistant nameplate indicating:

    a. Manufacturer's name, model number, and serial number.
    b. Body size.
    c. Body and trim materials.
    d. Flow arrow.

2.4 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

A. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.

B. Actuators for Steam Control Valves: Shutoff against 1.5 times steam design pressure.

C. Position indicator and graduated scale on each actuator.

D. Type: Motor operated, with or without gears, electric and electronic.

E. Voltage: 24-V ac.

F. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

G. Function properly within a range of 85 to 120 percent of nameplate voltage.

H. Construction:

1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

I. Field Adjustment:

1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

J. Two-Position Actuators: Single direction, spring return or reversing type.

K. Modulating Actuators:

1. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:

    a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.
    b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.
    c. Pulse Width Modulation (PWM): Actuator drives to a specified position according to pulse duration (length) of signal from a dry contact closure, triac sink, or source controller.
    d. Programmable Multi-Function:

        1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
        2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
        3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.

L. Position Feedback:

1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

M. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

N. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

O. Valve Attachment:

1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

P. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F ((minus 29 to plus 49 deg C)).
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

Q. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

R. Stroke Time:

1. Operate valve from fully closed to fully open within 15 seconds.
2. Operate valve from fully open to fully closed within 15 seconds.
3. Move valve to failed position within 15 seconds.
4. Select operating speed to be compatible with equipment and system operation.

S. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for valves installed in piping to verify actual locations of piping connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a excessive force.

D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that

could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

F. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

H. Corrosive Environments:

1. Use products that are suitable for environment to which they will be subjected.
2. If possible, avoid or limit use of materials in corrosive environments, including. but not limited to, the following:

    a. Laboratory exhaust airstreams.
    b. Process exhaust airstreams.

3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
5. Where control devices are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 CONTROL VALVES

A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

B. Install flanges or unions to allow drop-in and -out valve installation.

C. Where indicated, install control valve with three-valve bypass manifold to allow for control valve isolation and removal without interrupting system flow by providing manual throttling valve in bypass pipe.

D. Install drain valves in piping upstream and downstream of each control valve installed in a three-valve manifold and for each control valve larger than NPS 4 ((DN 100)).

E. Install pressure temperature taps in piping upstream and downstream of each control valve larger than NPS 2 ((DN 50)).

F. Valve Orientation:

1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
2. Install valves in a position to allow full stem movement.
3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

G. Clearance:

1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
2. Install valves with at least 12 inches (300 mm) of clear space around valve and between valves and adjacent surfaces.

H. Threaded Valves:

1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
2. Align threads at point of assembly.
3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

I. Flanged Valves:

1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.5 CONNECTIONS

A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with valve identification on valve and on face of ceiling directly below valves concealed above ceilings.

3.7 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.8 CHECKOUT PROCEDURES

A. Control Valve Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check valves for proper location and accessibility.
3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. For pneumatic products, verify air supply for each product is properly installed.
5. For pneumatic valves, verify that pressure gauges are provided in each air line to valve actuator and positioner.
6. Verify that control valves are installed correctly for flow direction.
7. Verify that valve body attachment is properly secured and sealed.
8. Verify that valve actuator and linkage attachment are secure.
9. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
10. Verify that valve ball, disc, and plug travel are unobstructed.
11. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.9 ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 23 09 23.11

SECTION 23 09 23.12

CONTROL DAMPERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes control dampers and actuators for DDC systems.

B. Related Requirements:

1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 23 09 93 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 23 09 23.12.

1.3 DEFINITIONS

A. DDC: Direct-digital control.

B. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.

2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include diagrams for air and process signal tubing.
5. Include diagrams for pneumatic signal and main air tubing.

C. Delegated-Design Submittal:

1. Schedule and design calculations for control dampers and actuators, including the following.

a. Flow at project design and minimum flow conditions.
b. Face velocity at project design and minimum airflow conditions.
c. Pressure drop across damper at project design and minimum airflow conditions.
d. AMCA 500D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
e. Maximum close-off pressure.
f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Product installation location shown in relationship to room, duct, and equipment.
2. Size and location of wall access panels for control dampers and actuators installed behind walls.
3. Size and location of ceiling access panels for control dampers and actuators installed above inaccessible ceilings.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control dampers to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to size products where indicated as delegated design.

D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

E. Backup Power Source: Systems and equipment served by a backup power source shall have associated control damper actuators served from a backup power source.

F. Environmental Conditions:

1. Provide electric control-damper actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control-damper actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.

a. Hazardous Locations: Explosion-proof rating for condition.

G. Selection Criteria:

1. Control dampers shall be suitable for operation at following conditions:

a. Supply Air: 55 degrees F and 4” W.G.
b. Return Air: 72 degrees F and 3” W.G.
c. Outdoor Air: 95 degrees F and 3” W.G..
d. Mixed Air: 55 to 95 degrees F and 4” W.G..
e. Exhaust Air: 72 degrees F and 3” W.G..

2. Fail positions unless otherwise indicated:

a. Supply Air: Last position.
b. Return Air: Last position.
c. Outdoor Air: Last position.
d. Mixed Air: Last position.
e. Exhaust Air: Last position.

3. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.
4. Select modulating dampers for a pressure drop of 5 percent of fan total static pressure unless otherwise indicated.
5. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.
6. Pneumatic, two-position control dampers shall provide a smooth opening and closing characteristic slow enough to avoid excessive pressure. Dampers with pneumatic actuators shall have an adjustable opening time (valve full closed to full open) and an adjustable closing time (valve full open to full closed) ranging from zero to 10 seconds. Opening and closing times shall be independently adjustable.
7. Control-damper, pneumatic-control signal shall not exceed 200 feet (60 m). For longer distances, provide an electric/electronic control signal to the damper and an electric solenoid valve or electro-pneumatic transducer at the damper to convert the control signal to pneumatic.

2.2 RECTANGULAR CONTROL DAMPERS

A. General Requirements:

1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.
3. Damper actuator shall be factory installed by damper manufacturer as integral part of damper assembly. Coordinate actuator location and mounting requirements with damper manufacturer.

B. Rectangular Dampers with Aluminum Airfoil Blades:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Arrow United Industries.
    b. Ruskin Company.

2. Performance:

    a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. (15.2 L/s per sq. m) against 1-in. wg (250-Pa) differential static pressure.
    b. Pressure Drop: 0.05-in. wg (12.5 Pa) at 1500 fpm (7.6 m/s) across a 24-by-24-inch (600-by-600-mm) damper when tested according to AMCA 500-D, figure 5.3.
    c. Velocity: Up to 6000 fpm (30 m/s).
    d. Temperature: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
    e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
    f. Damper shall have AMCA seal for both air leakage and air performance.

3. Construction:

    a. Frame:

        1) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles,0.07 inch (1.8 mm) thick.
        2) Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch (25 mm).
        3) Width not less than 5 inches (125 mm).

    b. Blades:

        1) Hollow, airfoil, extruded aluminum.
        2) Parallel or opposed blade configuration as required by application.
        3) Material: ASTM B 211, Alloy 6063 T5 aluminum, 0.07 inch (1.8 mm) thick.
        4) Width not to exceed 6 inches (150 mm).
        5) Length as required by close-off pressure, not to exceed 48 inches (1200 mm).

    c. Seals:

        1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
        2) Jambs: Stainless steel, compression type.

d. Axles: 0.5-inch- (13-mm-) diameter stainless steel, mechanically attached to blades.
e. Bearings:

1) Molded synthetic or stainless-steel sleeve mounted in frame.
2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:

1) Concealed in frame.
2) Constructed of aluminum and stainless steel.
3) Hardware: Stainless steel.

g. Transition:

1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
2) Factory mount damper in a sleeve with a close transition to mate to field connection.
3) Damper size and sleeve shall be connection size plus 2 inches (50 mm).
4) Sleeve length shall be not less than 12 inches (300 mm) for dampers without jackshafts and shall be not less than 16 inches (450 mm) for dampers with jackshafts.
5) Sleeve material shall match adjacent duct.

h. Additional Corrosion Protection for Corrosive Environments:

1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch (0.018 mm) thick.
2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

4. Airflow Measurement:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Ebtron, Inc.
2) Ruskin Company.

b. Where indicated, provide damper assembly with integral airflow monitoring.
c. Zero- to 10-V dc or 4- to 20-mA scaled output signal for remote monitoring of actual airflow.
d. Accuracy shall be within 5 percent of the actual flow rate between the range of minimum and design airflow. For applications with a large variation in range between the minimum and design airflow, configure the damper sections and flow measurement assembly as required to comply with the stated accuracy over the entire modulating range.
e. Provide a straightening device as part of the flow measurement assembly to achieve the specified accuracy with configuration indicated.
f. Suitable for operation in untreated and unfiltered air.
g. Provide temperature and altitude compensation and correction to maintain accuracy over temperature range encountered at site altitude.
h. Provide automatic zeroing feature.

5. Airflow Control:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Ebtron, Inc.
2) Ruskin Company.

b. Where indicated, provide damper assembly with integral airflow measurement and control.
c. A factory-furnished and -calibrated controller shall be programmed, in nonvolatile EPROM, with application-specific airflow set point and range.
d. The controller and actuator shall communicate to control the desired airflow.
e. The controller shall receive a zero- to 10-V dc input signal and report a zero- to 20-mA output signal that is proportional to the airflow.
f. Airflow measurement and control range shall be suitable for operation between 150 to 2000 fpm (0.8 to 10 m/s).
g. Ambient Operating Temperature Range: Minus 40 to plus 140 deg F (Minus 40 to plus 60 deg C).
h. Ambient Operating Humidity Range: 5 to 95 percent relative humidity, non-condensing.
i. Provide unit with control transformer rated for not less than 85 VA. Provide transformer with primary and secondary protection and primary disconnecting means. Coordinate requirements with field power connection.
j. Provide screw terminals for interface to field wiring.
k. Factory mount electronics within a NEMA 250, Type 1 painted steel enclosure.

2.3 ROUND CONTROL DAMPERS

A. Round Dampers, Sleeve Type:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Greenheck.
b. Ruskin Company.

2. Performance:

a. Leakage: Leakage shall not exceed 0.15 cfm/in. (0.0028 L/s per mm) of perimeter blade at 4-in. wg (1000-Pa) differential static pressure.
b. Pressure Drop: 0.02-in. wg (5 Pa) at 1500 fpm (7.6 m/s) across a 12-inch (300-mm) damper when tested according to AMCA 500-D, figure 5.3.
c. Velocity: Up to 4000 fpm (20 m/s).
d. Temperature: Minus 25 to plus 200 deg F (Minus 32 to plus 93 deg C).
e. Pressure Rating: 8-in. wg (2000 Pa) for sizes through 12 inches (300 mm), 6-in. wg (1500 Pa) for larger sizes.

3. Construction:

a. Frame:

1) Material: Galvanized steel, 0.04 in (1.0 mm) thick.

2) Outward rolled stiffener beads positioned approximately 1 inch (25 mm) inboard of each end.
3) Sleeve-type connection for mating to adjacent ductwork.
4) Size Range: 4 to 24 inches (100 to 600 mm).
5) Length not less than 7 inches (175 mm).
6) Provide 2-inch (50-mm) sheet metal stand-off for mounting actuator.

b. Blade: Double-thickness circular flat blades sandwiched together and constructed of galvanized steel.
c. Blade Seal: Polyethylene foam seal sandwiched between two sides of blades and fully encompassing blade edge.
d. Axle: 0.5-inch- (13-mm-) diameter plated steel, mechanically attached to blade.
e. Bearings: Stainless-steel sleeve pressed into frame.

B. Round Dampers, Flanged Type:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arrow United Industries.
b. Ruskin Company.

2. Performance:

a. Leakage: Leakage shall not exceed 0.15 cfm/in. (0.0028 L/s per mm) of perimeter blade at 4-in. wg (1000-Pa) differential static pressure.
b. Pressure Drop: 0.03-in. wg (7.5 Pa) at 1500 fpm (7.6 m/s) across a 12-inch (300-mm) damper when tested according to AMCA 500-D, figure 5.3.
c. Velocity: Up to 4000 fpm (20 m/s).
d. Temperature: Minus 25 to plus 250 deg F (Minus 32 to plus 121 deg C).
e. Pressure Rating: 8-in. wg (2000 Pa) for sizes through 36 inches (900 mm) in diameter, 6-in. wg (1500 Pa) for larger sizes.

3. Construction:

a. Frame:

1) Size Range: 4 to 60 inches (100 to 1500 mm).
2) Material: Galvanized steel.

a) Sizes through 24 Inches (600 mm) in Diameter: 0.15 inch (4 mm) thick.
b) Sizes 26 through 48 Inches (650 through 1200 mm) in Diameter: 0.25 inch (6 mm) thick.
c) Larger Sizes: 0.31 inch (8 mm) thick.

3) Flanges:

a) Outward rolled with bolt holes on each end of frame for mating to adjacent ductwork.
b) Face: Not less than 1.25 inch (31 mm) for damper sizes through 12 inches (300 mm) in diameter, 1.5 inch (38 mm) for damper sizes 14 through 24 inches (350 through 600 mm) in diameter, and 2 inches (50 mm) for larger sizes.

4) Length (Flange Face to Face): Not less than 8 inches (200 mm).
5) Provide 3-inch (75-mm) sheet metal stand-off for mounting actuator.

b. Blade: Reinforced circular flat blade constructed of galvanized steel.

1) Sizes through 24 Inches (600 mm): 0.15 inch (4 mm) thick.
2) Sizes 26 through 48 Inches ((650 through 1200 mm)): 0.19 inch ((5 mm)) thick.
3) Larger Sizes: 0.25 inch (6 mm) thick.

c. Blade Stop: Full circumference, located in airstream, minimum 0.5 by 0.25 inch (13 by 6 mm) galvanized- steel bar.
d. Blade Seal: Neoprene, mechanically attached to blade and fully encompassing blade edge.
e. Axle: stainless steel, mechanically attached to blade.

1) Sizes through 14 Inches ((350 mm)): 0.5 inch (13 mm) in diameter.
2) Sizes 16 through 42 Inches (400 through 1050 mm): 0.75 inch (19 mm) in diameter.
3) Larger Sizes: 1 inch (25 mm) in diameter.

f. Bearings: Stainless-steel sleeve pressed into frame.

2.4 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.

B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.

C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.

D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.

E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.

F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

G. Provide mounting hardware and linkages for connecting actuator to damper.

H. Select actuators to fail in desired position in the event of a power failure.

I. Actuator Fail Positions: As indicated below:

1. Exhaust Air: Last position.
2. Outdoor Air: Close.
3. Supply Air: Last position.

4. Return Air: Last position.

2.5 ELECTRIC AND ELECTRONIC ACTUATORS

A. Type: Motor operated, with or without gears, electric and electronic.

B. Voltage:

1. 24 V.
2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.

C. Construction:

1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

D. Field Adjustment:

1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.

E. Two-Position Actuators: Single direction, spring return or reversing type.

F. Modulating Actuators:

1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:

a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position, and other input drives actuator to close position. No signal of either input remains in last position.
b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- V dc or 4- to 20-mA signals.
c. Pulse Width Modulation (PWM): Actuator drives to a specified position according to a pulse duration (length) of signal from a dry-contact closure, triac sink or source controller.
d. Programmable Multi-Function:

1) Control input, position feedback, and running time shall be factory or field programmable.
2) Diagnostic feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
3) Service data, including at a minimum, number of hours powered and number of hours in motion.

G. Position Feedback:

1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

H. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

I. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

J. Damper Attachment:

1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

K. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F ((minus 29 to plus 49 deg C)).
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

L. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with a heater and controller where required by application.

M. Stroke Time:

1. Operate damper from fully closed to fully open within 60 seconds.
2. Operate damper from fully open to fully closed within 15 seconds.
3. Move damper to failed position within 15 seconds.
4. Select operating speed to be compatible with equipment and system operation.
5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

N. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for dampers and instruments installed in duct systems to verify actual locations of connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a <Insert valve> force.

C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Seal penetrations made in fire-rated and acoustically rated assemblies.

E. Fastening Hardware:

1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

G. Corrosive Environments:

1. Use products that are suitable for environment to which they will be subjected.
2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:

a. Laboratory exhaust airstreams.
b. Process exhaust airstreams.

3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
5. Where actuators are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 CONTROL DAMPERS

A. Install smooth transitions, not exceeding 15 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.

B. Clearance:

1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
2. Install dampers with at least 24 inches (600 mm) of clear space on sides of dampers requiring service access.

C. Service Access:

1. Dampers and actuators shall be accessible for visual inspection and service.
2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 233300 "Air Duct Accessories."

D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.

E. Attach actuator(s) to damper drive shaft.

F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

3.5 CONNECTIONS

A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."Section 16075 "Electrical Identification."

B. Install engraved phenolic nameplate with damper identification on damper and on face of ceiling where damper is concealed above ceiling.

3.7 CHECKOUT PROCEDURES

A. Control-Damper Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check dampers for proper location and accessibility.
3. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.
4. For pneumatic products, verify air supply for each product is properly installed.
5. For pneumatic dampers, verify that pressure gages are provided in each air line to damper actuator and positioner.
6. Verify that control dampers are installed correctly for flow direction.
7. Verify that proper blade alignment, either parallel or opposed, has been provided.
8. Verify that damper frame attachment is properly secured and sealed.
9. Verify that damper actuator and linkage attachment are secure.
10. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
11. Verify that damper blade travel is unobstructed.

3.8 ADJUSTMENT, CALIBRATION, AND TESTING:

A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressure.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 23 09 23.12

SECTION 23 09 23.14

FLOW INSTRUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Airflow sensors.
2. Airflow switches.
3. Airflow transmitters.
4. Liquid flow meters.
5. Liquid flow sensors.
6. Liquid flow switches.
7. Liquid flow transmitters.

B. Related Requirements:

1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 23 09 93 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 23 09 23.14.

1.3 DEFINITIONS

A. Ethernet: Local area network based on IEEE 802.3 standards.

B. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.

C. PEEK: polyetheretherketone.

D. PTFE: Polytetrafluoroethylene.

E. PPS: Polyphenylene sulfide.

F. RS-485: A TIA standard for multipoint communications using two twisted pairs.

G. RTD: Resistance temperature detector.

H. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include diagrams for air and process signal tubing.
5. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

C. Delegated-Design Submittal:

1. Schedule and design calculations for flow instruments, including the following.

a. Flow at Project design and minimum flow conditions.
b. Pressure drop at Project design and minimum flow conditions.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each product requiring a certificate.

B. Product Test Reports: For each product, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Provide parts, as indicated by manufacturer's recommended parts list, for product operation during one-year period following warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Select and size products to achieve specified performance requirements.

B. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 GENERAL REQUIREMENTS FOR FLOW INSTRUMENTS

A. Air sensors and transmitters shall have an extended range of 10 percent above Project design flow and 10 percent below minimum Project flow to signal abnormal flow conditions and to provide flexibility for changes in operation.

B. Liquid and steam sensors, meters, and transmitters shall have an extended range of 10 percent above Project design flow and 10 percent below Project minimum flow to signal abnormal flow conditions and to provide flexibility for changes in operation.

2.3 AIRFLOW SENSORS:

A. Performance Requirements:

1. Adjustable for changes in system operational parameters.
2. Airflow Sensor and Transmitter Range: Extended range of 10 percent above Project design flow and 10 percent below minimum Project flow to signal abnormal flow conditions.
3. Manufacturer shall certify that each flow instrument indicated complies with specified performance requirements and characteristics.

    a. Product certificates are required.

B. Pitot-Tube Airflow Sensor Station:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Air Monitor Corporation.
    b. Ruskin Company.

2. Description: Multiple total- and static-pressure sensors positioned at the center of equal area of the station cross section and interconnected by respective averaging manifolds.

a. Stations 4 sq. ft. (0.4 sq. m) and Smaller: One total-pressure sensor and one static-pressure sensor for every 16 sq. in. (103 sq. cm) of station area.
b. Stations Larger than 4 sq. ft. (0.4 sq. m): One total-pressure sensor and one static-pressure sensor for every 36 sq. in. (232 sq. cm) of station area.

3. Casing: Galvanized sheet steel at least 0.079 inch (2.0 mm) thick with coating complying with ASTM A 653/A 653M, G90 ((Z275)). Casings shall be stainless steel, 0.0781 inch (2.0 mm) thick, when connected to stainless duct and aluminum, 0.063 inch (1.6 mm) thick, when connected to aluminum duct.

   a. Joints and Seams: Continuously weld. Clean galvanized areas damaged by welding and coat with aluminum paint.
   b. Casing Depth: At least 8 inches (200 mm).
   c. Casing Flanges: Outward flange, minimum flange face 1.5 inches (38 mm).
   d. Casing Configuration and Size: Match shape (rectangular, round, flat oval) and same size as adjacent duct unless otherwise indicated.

4. Include an open parallel cell air straightener or air equalizer honeycomb mechanically fastened to casing.

   a. Construct straightener or equalizer from Type 3003 aluminum or Type 316 stainless steel, depending on casing material. Use stainless steel for units with stainless-steel casings.

5. Construct pressure sensor array from drawn copper or stainless-steel tubing. Use stainless steel for units with stainless-steel casings. Copper tubing shall comply with ASTM B 75 and ASTM B 280. Minimum tube wall thickness shall be 0.030 inch (0.8 mm). Include internal piping and external pressure transmitter ports.
6. Station Labeling: Identification label on each station casing indicating model number, size, area, and application-specific airflow range.
7. Performance:

   a. Pressure Loss: 0.015-inch wg (3.8 Pa) at 1000 fpm (5 m/s), or 0.085-inch wg (22.5 Pa) at 2000 fpm (10 m/s).
   b. Accuracy: Within 2 percent of actual airflow.
   c. Self-Generated Sound: NC 40 and sound level within the duct shall not be amplified.
   d. Performance rated and tested according to AMCA 610. Each station shall bear the AMCA seal.

C. Pitot-Tube Fan Inlet Airflow Traverse Sensor:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Air Monitor Corporation.
   b. Ruskin Company.

2. Traverse manifold designed for mounting in fan inlets.
3. Contain multiple total- and static-pressure sensors placed at concentric area centers along the exterior surface of cylindrical manifold and internally connected to their respective averaging manifolds. Sensors shall not protrude beyond the surface of the manifold nor be adversely affected by particle contamination present in airstream.

4. Manifold (two per inlet) shall have dual end support swivel brackets suitable for mounting in the fan inlet bell and symmetrical averaging signal takeoffs and fittings.
5. Sensors shall be capable of producing steady, non-pulsating signals of standard total- and static-pressure without need for flow corrections or factors, with an accuracy of 3 percent of actual flow over a turndown range of 6 to 1.
6. Manifold Materials: Copper or anodized aluminum or Type 316 stainless steel.
7. Unless otherwise required by application and without affecting the fan and sensor performance, nominal diameter copper and aluminum manifolds shall be the following:

    a. For Fan Inlets Smaller than 20 Inches (500 mm): 0.375 inch (9 mm).
    b. For Fan Inlets 20 Inches (500 mm) and Larger: 0.75 inch (19 mm).

8. Unless otherwise required by application and without affecting the fan and sensor performance, nominal diameter stainless-steel manifolds shall be the following:

    a. For Fan Inlets Smaller than 20 Inches (500 mm): 0.375 inch (9 mm).
    b. For Fan Inlets 20 through 48 Inches (500 through 1200 mm): 0.75 inch (19 mm).
    c. For Fan Inlets Larger than 48 Inches (1200 mm): 1.0 inch (25 mm).

D. Piezometer Ring Fan Inlet Airflow Sensor:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Twin City Fan & Blower.
    b. Ruskin Company.

2. In lieu of externally mounted fan inlet airflow sensors, option to provide fans with airflow measurement integral to fan inlet cones for continuous measurement of air volume flow rate.
3. Multiple pressure sensor points strategically placed along the circumference of the inlet cone and internally connected to an averaging ring manifold located behind the inlet cone.
4. Sensor points shall not protrude beyond the surface of the inlet cone nor be adversely affected by particle contamination present in the airstream.
5. Sensor shall produce steady, non-pulsating signals to achieve accuracy within 5 percent of actual airflow.
6. Sensor shall be non-intrusive and not impact fan performance.
7. Product shall be a standard offering of the fan manufacturer and include published literature with supporting test data to validate sensor performance.

E. Thermal Airflow Station:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Ebtron, Inc.
    b. Onicon, Inc

2. Source Limitations: Obtain airflow and temperature measuring sensors and transmitters from single manufacturer.
3. Description: Airflow station shall consist of one or more sensor probes mounted in a casing, and a remotely mounted microprocessor-based transmitter.

4. Performance:

    a. Capable of independently processing up to 16 Insert number independently wired sensor assemblies.
    b. Airflow rate of each sensor assembly shall be equally weighted and averaged by transmitter prior to output.
    c. Temperature of each sensor assembly shall be velocity weighted and averaged by transmitter prior to output.
    d. Listed and labeled by an NRTL as successfully tested as an assembly according to UL 873, "Temperature-Indicating and Regulating Equipment."
    e. Components shall be interconnected by exposed NRTL-listed plenum-rated cable or non-listed cable placed in conduit.
    f. Each flow station shall be factory calibrated at a minimum of 16 airflow rates and three temperatures to standards that are traceable to NIST.
    g. Airflow Accuracy: Within 3 percent of reading over the entire operating airflow range.

        1) Devices whose accuracy is combined accuracy of transmitter and sensor probes must demonstrate that total accuracy meets the performance requirements throughout the measurement range.

    h. Temperature Accuracy: Within 0.2 deg F (0.11 deg C) over entire operating range of minus 20 to plus 140 deg F (minus 29 to plus 60 deg C).
    i. Sensor Ambient Operating Temperature Range: Minus 20 to plus 160 deg F (Minus 29 to plus 71 deg C).
    j. Transmitter Ambient Operating Temperature Range: Minus 20 to plus 120 deg F (Minus 29 to plus 49 deg C).
    k. Sensor and Transmitter Ambient Operating Humidity Range: Zero to 99 percent, non-condensing.
    l. Instrument shall compensate for changes in air temperature and density throughout calibrated velocity range for seasonal extremes at Project location.
    m. Pressure Drop: 0.05-inch wg (12.5 Pa) at 2000 fpm (10.2 m/s) across a 24-by-24-inch (600-by-600-mm) area.
    n. Instruments mounted in throat or face of fan inlet cone shall not negatively influence fan performance by reducing flow more than 2 percent of Project design flow or negatively impact fan-generated sound. Losses in performance shall be documented with submittal data, and adjustments to compensate for performance impact shall be made to fan in order to deliver Project design airflow indicated.

5. Sensor Assemblies:

    a. Each sensor probe shall contain two individually wired, hermetically sealed bead-in-glass thermistors.
    b. Mount thermistors in sensor using a marine-grade, waterproof epoxy.
    c. Thermistor leads shall be protected and not exposed to the environment.
    d. Each sensor assembly shall independently determine airflow rate and temperature at each measurement point.
    e. Each sensor probe shall have an integral cable for connection to remotely mounted transmitter.
    f. Sensor Probe Material: Gold anodized, extruded 6063 aluminum tube or Type 304 stainless steel.
    g. Probe Assembly Mounting Brackets Material: Type 304 stainless steel.

6. Casing:

a. Factory mount sensor probes in an airflow station casing to create a single assembly for field mounting.
b. Material: Galvanized sheet steel at least 0.079 inch (2.0 mm) thick with coating complying with ASTM A 653/A 653M, G90 ((Z275)). Casings shall be stainless steel, 0.0781 inch (2.0 mm) thick, when connected to stainless duct and aluminum, 0.063 inch (1.6 mm) thick, when connected to aluminum duct.
c. Joints and Seams: Continuously weld. Clean galvanized areas damaged by welding and coat with zinc-rich paint.
d. Casing Depth: At least 8 inches (200 mm).
e. Include casing inlet and discharge connections with a minimum 2-inch ((50-mm)) face flange.

7. Transmitter:

a. Integral digital display capable of simultaneously displaying total airflow and average temperature, individual airflow, and temperature readings of each independent sensor assembly.
b. Capable of field configuration and diagnostics using an onboard push-button interface and digital display.

1) Include an integral power switch to operate on 24-V ac (isolation not required) and include the following:

a) Integral protection from transients and power surges.
b) Circuitry to ensure reset after power disruption, transients, and brownouts.
c) Integral transformer to convert field power source to operating voltage required by instrument.

c. Remote Signal Interface:

1) Linear Analog Signals for Airflow and Temperature: Fuse protected and isolated, field selectable,] zero- to 10-V dc or 4 to 20 mA.
2) RS-485: BACnet-ARCNET, BACnet-MS/TP, and Modbus-RTU.
3) 10 Base-T Ethernet: BACnet Ethernet, BACnet-IP, Modbus-TCP, and TCP/IP.
4) LonWorks free topology.

2.4 AIRFLOW SWITCHES

A. Polymer Film Sail Switch:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Honeywell International Inc.
b. Dwyer Instruments, Inc.

2. Performance:

a. Suitable for applications operating at velocities up to 400 fpm (2.0 m/s).
b. Suitable for mounting with air direction in horizontal, vertical up or down.

c. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
d. Voltage: 24-, 120-, 240-V ac.
e. Normally Open Full Load Current: 2 A at 120-V ac.
f. Normally Closed Full Load Current: 1 A at 120-V ac.
g. Normally open switch actuates at 250 fpm (1.3 m/s) and opens at 75 fpm (0.4 m/s).
h. Normally closed switch actuates at 75 fpm (0.4 m/s) and closes at 250 fpm (1.3 m/s).
i. Maximum Process Temperature: 170 deg F (77 deg C).
j. Maximum Ambient Temperature: 125 deg F (52 deg C).

3. Construction:

a. Polyester film sail encasing a wire frame.
b. Sail actuates a SPDT snap switch.
c. Enclosure Material: Zinc-plated steel.
d. Enclosure with removable cover.
e. NEMA 250, Type 1 enclosure.
f. Removable spring counterbalances sail to allow mounting in either vertical (up or down) or horizontal airflow.
g. Electrical Connections: Screw terminals.
h. Conduit Connections: 1/2-inch (16-mm) trade size conduit knock outs on top and bottom.

B. Stainless-Steel Single Vane Switch:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Dwyer Instruments, Inc.
b. Honeywell International Inc.

2. Description:

a. Velocities up to 2000 fpm (10.2 m/s).
b. Suitable for mounting with air direction in horizontal.

3. Performance:

a. Voltage: 125-, 240-, and 480-V ac.
b. Full Load Current: 9.8 A at 125-V ac.
c. Field-Adjustable Velocity Set Point: 400 to 1600 fpm (2.0 to 8.2 m/s).
d. Maximum Process Temperature: 180 deg F (82 deg C).
e. Maximum Ambient Temperature: 125 deg F (52 deg C).

4. Construction:

a. Stainless-steel vane.
b. Vane actuates a SPDT snap switch.
c. Enclosure Material: Die-cast metal.
d. Enclosure with removable cover.
e. NEMA 250, Type 1 enclosure.
f. Screw set-point adjustment.
g. Electrical Connections: Screw terminals.

h. Conduit Connections: 1-inch (27-mm) trade size conduit knock outs on top and bottom.

2.5 AIRFLOW TRANSMITTERS

A. Airflow Transmitter with 0.10 Percent Accuracy and Auto-Zero Feature:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Air Monitor Corporation.
   b. Onicon Inc

2. Transmitter shall receive total- and static-pressure signals from a primary element, amplify signals, extract the square root, and scale the signals to produce 4- to 20-mA dc output signals linear to airflow.
3. NEMA 250, Type 1 enclosure.
4. Construct assembly so that shock, vibration, and pressures surges of up to 1 psig (6.9 kPa) will neither harm transmitter, nor affect its accuracy.
5. Transmitter with automatic zeroing circuit capable of automatically readjusting transmitter zero at predetermined time intervals. The automatic zeroing circuit shall re-zero transmitter to within 0.1 percent of true zero.
6. Performance:

   a. Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
   b. Calibrated Span: Field adjustable, minus 40 percent of the range.
   c. Accuracy: Within 0.10 percent of natural span.
   d. Repeatability: Within 0.15 percent of calibrated span.
   e. Linearity: Within 0.2 percent of calibrated span.
   f. Hysteresis and Deadband (Combined): Less than 0.2 percent of calibrated span.

7. Integral digital LED or digital display for continuous indication of airflow.

B. Airflow Transmitters with 0.25 Percent Accuracy and Auto-Zero Feature:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Air Monitor Corporation.
   b. Onicon, Inc.

2. Transmitter shall receive total- and static-pressure signals from a flow element, amplify signals, extract the square foot, and scale the signals to produce 4- to 20-mA dc output signals linear to airflow.
3. NEMA 250, Type 1 enclosure.
4. Construct assembly so shock, vibration, and pressures surges of up to 1 psig (6.9 kPa) will neither harm transmitter, nor affect its accuracy.
5. Transmitter with automatic zeroing circuit capable of automatically readjusting transmitter zero at predetermined time intervals. The automatic zeroing circuit shall re-zero the transmitter to within 0.1 percent of true zero.
6. Performance:

a. Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
b. Calibrated Span: Field adjustable, minus 40 percent of the range.
c. Accuracy: Within 0.25 percent of natural span.
d. Repeatability: Within 0.15 percent of calibrated span.
e. Linearity: Within 0.2 percent of calibrated span.
f. Hysteresis and Deadband (Combined): Less than 0.2 percent of calibrated span.

7. Integral digital display for continuous indication of airflow.

C. Pressure Differential Transmitters for Airflow Measurement:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Setra System.
b. Onicon, Inc

2. Performance:

a. Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
b. Accuracy: Within [1] [0.5] [0.4] [0.25] percent of the full-scale range.
c. Hysteresis: Within 0.10 percent of full scale.
d. Repeatability: Within 0.05 percent of full scale.
e. Stability: Within one percent of span per year.
f. Overpressure: 10 psig (69 kPa).
g. Temperature Limits: Zero to 150 deg F (Minus 18 to plus 66 deg C).
h. Compensate Temperature Limits: 40 to 150 deg F (4 to 66 deg C).
i. Thermal Effects: 0.033 percent of full scale per degree F.
j. Shock and vibration shall not harm the transmitter.

3. Output Signals:

a. Analog Current Signal:

1) Two-wire, 4- to 20-mA dc current source.
2) Signal capable of operating into 800-ohm load.

b. Analog Voltage Signal:

1) Three wire, zero to 10 V.
2) Minimum Load Resistance: 1000 ohms.

4. Display: Four-digit digital with minimum 0.4-inch- (10-mm-) high numeric characters.
5. Operator Interface:

a. Zero and span adjustments located behind cover.

6. Construction:

a. Plastic casing with removable plastic cover.
b. Fittings: Swivel fittings for connection to copper tubing or barbed fittings for connection to polyethylene tubing. Fittings on bottom of instrument case.

c. Screw terminal block for wire connections.
d. Vertical plane mounting.
e. NEMA 250, Type 4.
f. Mounting Bracket: Appropriate for installation.

D. Pressure Differential Indicating Transmitter, Switch, and Controller for Airflow Measurement:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Dwyer Instruments, Inc.
b. Honeywell International Inc.

2. Description:

a. Three-in-one instrument, including digital display, control relay switches, and a transmitter with a current output.
b. Field configurable for pressure, velocity, and volumetric flow applications through user interface.
c. Select instrument range based on application.

3. Performance:

a. Accuracy including hysteresis and repeatability:

1) Ranges Less than 5-Inch wg (1250 Pa): Within 1 percent.
2) Other Ranges: Within 0.5 percent at 77 deg F (25 deg C).

b. Stability: Within 1 percent per year.
c. Response Time: 250 ms.
d. Overpressure:

1) Ranges Less than 50-Inch wg (12.5 kPa): 5 psi ((34.5 kPa).)
2) Range of 100-Inch wg (25 kPa): 9 psi (62 kPa).

e. Temperature Limits: 32 to 140 deg F (Zero to 60 deg C).
f. Thermal Effects: 0.020 percent per deg F ((deg C)).
g. Warm-up Period: One hour.

4. Controller: Programming through menu keys to access five menus.

a. Security level.
b. Pressure, velocity, or flow application.
c. Engineering units.
d. K-factor for use with flow application.
e. Set-point control only; set-point and alarm operation; alarm operation as high, low, or high/low with manual; or automatic reset and delay.
f. View high and low readings.
g. Digital dampening for smoothing erratic applications.
h. Scaling of analog output to fit range and field calibration.

5. Display:

a. Four-digit digital, with minimum 0.4-inch- (10-mm-) high alphanumeric characters.

b. Four LED indicators; two LEDs for set point and two LEDs for alarm status.

6. Operator Interface:

a. Set-point adjustment through keypad on face of instrument.
b. Zero and span adjustments accessible through menu.
c. Programming through keypad.

7. Output Analog Signal: Two-wire, 4- to 20-mA dc current source; capable of operating into a 900-ohm load.
8. Output Digital Signal: Two, SPDT relays; each rated for 1 A at 30-V ac or 30-V dc.
9. Construction:

a. Die-cast aluminum casing and bezel.
b. Connections on side and back.
c. Vertical plane mounting.
d. NEMA 250, Type 1 rating.
e. Nominal 4-inch- (100-mm-) diameter face.
f. Mounting Bracket: Appropriate for installation.

2.6 LIQUID FLOW METERS

A. General Requirements for Liquid Flow Meters:

1. Adjustable for changes in system operational parameters.
2. Liquid and Steam Sensors, Meters, and Transmitters: Extended range of 20 percent above Project design flow and 20 percent below Project minimum flow to signal abnormal flow conditions.
3. Manufacturer shall certify that each flow instrument indicated complies with specified performance requirements and characteristics.
4. Product certificates are required.

B. Insertion Paddle Wheel Flow Meter, NPS 2 (DN 50):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Badger Meter, Inc.
b. Veris Industries.

2. Description: Insertion-type meter with a non-magnetic spinning paddle wheel.
3. Performance:

a. Range: 0.5 to 30 fps (0.15 to 9.1 mps).
b. Accuracy: Within 1 percent of full scale over flow range.
c. Linearity: Within 0.2 percent of full scale over flow range.
d. Repeatability: Within 0.3 percent of full scale over flow range.
e. Ambient Temperature: 14 to 150 deg F (Minus 10 to plus 66 deg C).
f. Maximum Process Temperature: [221 deg F ((105 deg C))] [285 deg F ((141 deg C))].
g. Maximum Pressure: 400 psig at 100 deg F (2758 kPa at 38 deg C).

4. Output Signal: Frequency pulse.
5. Construction:

a. Wetted Metal Parts, Including Sensor Sleeve, Mounting Adapter, and Isolation Valve: Brass.
b. Shaft: Titanium.
c. Impeller: Nylon.
d. Process Connection: NPS 2 ((DN 50)).
e. Instrument Isolation Valve: Full port ball valve for system isolation.
f. Insertion Depth: Threaded positioning nut for accurate sensor depth in the pipe.
g. Electronics Enclosure:

1) Polyphenylene sulfide (PPS) with Viton seal.
2) Electrical Connection: Cable furnished with sensor.

6. Transmitter:

a. User-adjustable scale to refine resolution of flow range over 4- to 20-mA signal.
b. Enclosure Material: Polycarbonate with tongue and groove, with neoprene sealed cover.
c. NEMA 250, Type 4X enclosure.
d. Electrical Connection: Screw terminals.
e. Linearity less than one percent.
f. Output Response Time: 6 seconds for 10 to 90 percent step.
g. Load resistance of 650 ohms at 24-V dc.
h. Operating Temperature: Minus 32 to plus 122 deg F (Minus 36 to plus 50 deg C).
i. Digital display of flow rate.

C. Insertion Paddle Wheel Flow Meter, NPS 1 (DN 25):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Badger Meter, Inc.

2. Description:

a. Insertion-type meter with a non-magnetic spinning paddle wheel.
b. Each meter shall be wet calibrated at factory to standards traceable to NIST and provided with a certificate of calibration.
c. Programming kit including cable connector and Microsoft-Windows-compatible software.
d. Where indicated, provide meter with bi-directional flow measurement.

3. Performance:

a. Range: 0.33 to 20 fps (0.1 to 6.1 m/s).
b. Accuracy: Within [0.5] [1] percent of flow rate.
c. Repeatability: Within 0.5 percent.
d. Ambient Temperature: 14 to 150 deg F ((Minus 10 to plus 66 deg C)).
e. Maximum Process Temperature: 300 deg F (149 deg C) with PEEK sensor tip.
f. Maximum Pressure: 350 psig at 300 deg F (2413 kPa at 149 deg C) with PEEK sensor tip.
g. Pressure Drop: Up to 0.5 psig at 10 fps (3.5 kPa at 3 m/s) for pipe sizes NPS 1-1/2 (DN 20) and larger.

4. Output Signal:

a. Unidirectional Flow Meter: Frequency pulse.
b. Unidirectional Flow Meter: Analog, two wire, loop-powered, 4- to 20-mA signal.
c. Unidirectional Flow Meter: Scaled pulse.
d. Bi-directional Flow Meter: Analog 4- to 20-mA signal plus direction.
e. Bi-directional Flow Meter: Scaled pulse.

5. Operator Interface:

a. Programming: Instrument programming through computer and programming kit.
b. Digital Display: Eight-character digital display of flow rate, flow totalization, input, output, and flow direction for bi-directional meters.

6. Construction:

a. Wetted Metal Parts (Including Sensor Stem, Mounting Adapter, and Isolation Valve): Type 316 stainless steel.
b. Sensor Tip: PPS or PEEK.
c. Shaft: Tungsten carbide.
d. Impeller: Stainless steel.
e. Process Connection: NPS 1 (DN 25).
f. Instrument Isolation Valve: Full port ball valve for system isolation.
g. Insertion Depth: Threaded positioning nut for accurate sensor depth in the pipe.
h. Electronics Enclosure:

1) Polypropylene with Viton-sealed acrylic cover.
2) Removable cover.
3) NEMA 250, Type 4X.
4) Electrical Connection: Screw terminals.
5) Conduit Connection: 1/2-inch ((16-mm))trade size.

D. Insertion Turbine Flow Meter:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ONICON Incorporated.
b. Spirax Sarco Limited.

2. Description:

a. Operating pressure of 300 psig (2068 kPa) with a temperature of 200 deg F (93 deg C).
b. Meters in hot water systems shall be suitable for maximum system temperatures encountered, but not less than 250 deg F (121 deg C).
c. Pressure drop not to exceed 1 psig (6.9 kPa) at 20-fps (6.1-m/s) flow velocity in a NPS 2 (DN 50) pipe and decreasing in large pipe with lower velocity.
d. Sensor Accuracy:

1) Within 1 percent of actual flow between the flow velocity range of 3 to 30 fps (0.9 to 9.1 m/s).
2) Within 2 percent of actual flow between the flow velocity range of 0.4 to 20 fps (0.1 to 6.1 m/s).
3) Within 0.5 percent of actual reading at the calibrated velocity.

e. Wet calibrate and tag sensors to standards traceable to NIST, and provide each sensor with a certificate of calibration.

3. Sensor:

a. For Pipe Sizes NPS 2 (DN 50) and Smaller: Single turbine sensors.
b. For Pipe Sizes NPS 2-1/2 (DN 65) and Larger: Dual turbine sensors.
c. Piping with Bi-directional Flow: Bi-directional dual turbine sensors.
d. Dual turbine sensors shall have dual, contra-rotating turbine elements, each turbine element with its own rotational sensing system, and an averaging circuit.
e. Rotational sensing of each turbine shall be accomplished electronically by sensing electronic impedance change (non-magnetic and non-photoelectric).
f. Sensor shall have an integral frequency output linear with flow rate. For dual turbine units, with individual top and bottom turbine outputs for diagnostic purposes.
g. Bi-directional sensors shall have isolated solid-state dry contacts with a contact rating of 100 mA at 50 V. The contacts shall close when the flow in direction of arrow is 0.18 fps (0.05 m/s) or more.
h. Flow sensor shall be complete with installation hardware necessary to enable insertion and removal from pipe without system shutdown.
i. Construct turbine elements of polypropylene with sapphire jewel bearings and tungsten carbide shafts. Construct wetted metal components of Type 316 stainless steel, including installation hardware.
j. House sensor electronics in a NEMA 250, Type 4 enclosure.
k. Enclosure shall include connection(s) for field-installed conduit.
l. Sensor shall have cable of length sufficient to connect to display module.
m. Sensor housing shall have full port Type 316 stainless-steel ball valve for system isolation.

4. Display Module:

a. Remote from sensor.
b. House in a NEMA 250, Type 4X enclosure.
c. Label terminal strip for all wiring connections.
d. 120-V ac power supply with 24-V dc output to power the flow sensor.
e. Remote Interface:

1) Hardwired Analog Outputs for Flow Rate and Totalization: 4 to 20 mA and zero- to 10-V dc.
2) Serial Communication Interface: Compatible with host to share flow rate and totalized flow data.
3) Outputs linear to within 0.1 percent of calibrated span.

f. Digital display for flow rate and totalized flow.

1) At least eight display digits for totalization.
2) Bi-directional units with separate digital display for flow and totalization in each direction.

g. Local reset of flow totalization.
h. Program and data shall be stored in nonvolatile memory in event of power loss.
i. For bi-directional units, with display of flow direction (contacts open or closed).

E. Inline Turbine Flow Meter:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. ONICON Incorporated.
    b. Rosemont

2. Description:

    a. Available in NPS 3/4 and NPS 1 (DN 20 and DN 25).
    b. Operating pressure of 300 psig (2068 kPa) with a temperature of 200 deg F (93 deg C).
    c. Meters in hot water systems shall be suitable for maximum system temperatures encountered, but not less than 250 deg F (121 deg C).
    d. Pressure drop not to exceed 3 psig at 38 gpm (21 kPa at 2.4 L/s).
    e. Sensor Accuracy:

        1) Within 2 percent of actual flow between the flow range of 0.8 to 38 gpm (0.05 to 2.4 L/s).
        2) Within 0.5 percent of actual reading at the calibrated velocity.

    f. Wet calibrate and tag sensors to standards traceable to NIST, and provide each sensor with a certificate of calibration.

3. Sensor:

    a. Rotational sensing of turbine shall be accomplished electronically by sensing electronic impedance change (non-magnetic and non-photoelectric).
    b. Sensor shall have an integral frequency output linear with flow rate.
    c. Sensor shall have threaded union on each end.
    d. Construct turbine elements of polypropylene with sapphire jewel bearings and tungsten carbide shafts.
    e. Construct wetted metal components of brass or stainless steel.
    f. House sensor electronics in a NEMA 250, Type 4 enclosure.
    g. Enclosure shall include connection(s) for field-installed conduit.
    h. Sensor shall have cable of length sufficient to connect to display module.

4. Display Module:

    a. Remote from sensor.
    b. Enclosure: NEMA 250, Type 4X.
    c. Label terminal strip for all wiring connections.
    d. 120-V ac power supply with 24-V dc output to power the flow sensor.
    e. Remote Interface:

        1) Hardwired Analog Outputs for Flow Rate and Totalization: 4 to 20 mA and zero- to 10-V dc.
        2) Serial Communication Interface: Compatible with host to share flow rate and totalized flow data.
        3) Outputs linear to within 0.1 percent of calibrated span.

    f. Digital display of flow rate and totalized flow.
    g. At least eight display digits for totalization.
    h. Local reset of flow totalization.
    i. Program and data shall be stored in nonvolatile memory in the event of power loss.

F. In-line Body Electromagnetic Flow Meter:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ONICON Incorporated.
    b. Spirax Sarco Limited.

2. Description:

    a. No moving parts.
    b. Suitable for flow measurement of fluids with electrical conductivity more than 5 micro-Seimens per cm.
    c. Inherent bi-directional flow measurement.
    d. Flow measurement with three pipe diameters upstream and two pipe diameters downstream.
    e. Wet calibrate and tag meters to standards traceable to NIST, and provide each meter with a certificate of calibration.
    f. Transmitter integral to meter.

3. Performance:

    a. Accuracy for Velocities between 3.3 and 33 fps (1 and 10 m/s): Within 0.2 percent of reading.
    b. Accuracy for Velocities between 1.0 and 3.3 fps (0.3 and 1 m/s): Within 0.75 percent of reading.
    c. Accuracy for Velocities Less than 1.0 fps ((0.3 m/s)): Within 0.0075 fps (0.0023 m/s).
    d. Ambient Temperature: Minus 4 to plus 140 deg F (Minus 20 to plus 60 deg C).
    e. Process Temperature: Minus 4 to 212 deg F (Minus 20 to plus 100 deg C).
    f. Pressure: 225 psig (1551 kPa).

4. Analog Output Current Signal:

    a. Two-wire, 4- to 20-mA dc current source.
    b. Signal capable of operating into 1000-ohm load.
    c. Isolated.

5. Digital Output Signal: Two, programmable, digital/pulse outputs configurable for frequency, pulse, or directional flow.
6. Operator Interface:

    a. Keypad.
    b. Digital Display: Multiple-line digital display of alphanumerical characters.
    c. LED for normal and alarm operation.

7. Construction:

    a. Body: Type 316 stainless steel.
    b. Body Liner Material: Ebonite.
    c. Flow Tube: Type 304 stainless steel.
    d. Connection: 300 Class flange Threaded.
    e. Electrodes: Type 316 stainless steel. Quantity determined by manufacturer based on application.
    f. Electronics Enclosure:

1) Painted aluminum.
2) Removable cover.
3) NEMA 250, Type 6.

G. Insertion Electromagnetic Flow Meter:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ONICON Incorporated.
b. Spirax Sarco Limited.

2. Description:

a. No moving parts.
b. Suitable for flow measurement of fluids with electrical conductivity between 20 to 60000 micro-Seimens per centimeter.
c. Suitable for pipe sizes NPS 3 through NPS 72 (DN 80 through DN 1800).
d. Wet calibrate and tag meters to standards traceable to NIST, and provide each meter with a certificate of calibration.
e. Continuous auto-zero function.
f. Transmitter integral to meter.

3. Performance:

a. Flow Range: 0.25 to 20 fps (0.08 to 6.1 m/s).
b. Accuracy for Velocities between 2 and 20 fps (0.6 to 6.1 m/s): Within 1 percent of reading.
c. Accuracy for Velocities Less than 2 fps (0.6 m/s): Within 0.02 fps (0.006 m/s).
d. Ambient Temperature: Minus 5 to 150 deg F (Minus 21 to plus 66 deg C).
e. Process Temperature: 15 to 250 deg F (Minus 9 to plus 121 deg C).
f. Pressure: 400 psig (2758 kPa).

4. Output Signals:

a. Field-selectable analog signals.

1) Current Signal (Isolated): 4 to 20 mA.
2) Voltage Signal (Isolated): Zero- to 10-V dc.

b. Digital Signal: Dry-contact closure signaling fault condition.
c. Frequency Signal: Zero- to 15-V peak pulse, zero to 500 Hz.
d. Scalable Pulse Output:

1) Isolated solid-state dry contact.
2) Contact Rating: 100 mA at 50-V dc.
3) Pulse Duration: 0.5, 1, 2, or 6 seconds.

5. Construction:

a. Wetted Metal Parts: Type 316 stainless steel.
b. Sensor Head: Polysulfone.
c. Process Connection: 1-inch (25-mm).

d. Instrument Isolation Valve: Full port Type 316 stainless-steel ball valve for system isolation.
e. Electrodes: Type 316 stainless steel.
f. Electronics Enclosure:

1) Painted aluminum.
2) Removable cover.
3) NEMA 250, Type 4.
4) Electrical Connection: PVC-jacketed cable, 10 feet (3 m) long.
5) Conduit Connection:1/2-inch ((16 mm))trade size.

6. Display Module:

a. Remote from meter.
b. House in a NEMA 250, Type 4X enclosure.
c. Label terminal strip for all wiring connections.
d. 120-V ac power supply with 24-V dc output to power the flow sensor.
e. Input Signal from Meter: Zero- to 15-V pulse output.
f. Output Signals: Additional output signals furnished with flow meter connected to display module terminal strip.
g. Auxiliary Output Signals: Analog current output (isolated) shall be 4 to 20 mA.
h. Auxiliary Output Signals: Analog voltage output (isolated) shall be zero to [5] [10] V.
i. Auxiliary Output Signals: Digital output (isolated) shall be solid-state dry contacts rated for 100 mA at 50 V.
j. Digital Display:

1) Flow rate.
2) Totalized flow.
3) At least six display digits for flow rate and eight display digits for totalization.
4) Bi-directional units with separate digital display for flow and totalization in each direction.

k. Local reset of flow totalization.
l. Program and data shall be stored in nonvolatile memory in the event of power loss.
m. For bi-directional units, provide LED display of flow direction (contacts open or closed).

H. Vortex Shedding Flow Meter with Integral Temperature Measurement:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ONICON Incorporated.
b. Spirax Sarco Limited.

2. Description:

a. Flow measurement using vortex shedder body with integral 1000-ohm platinum RTD.
b. Meter NPS 3/8 through NPS 8 (DN 10 through DN 200).
c. Each meter shall be factory calibrated at five points from zero to 250 fps (zero to 76 m/s) and tagged accordingly against the manufacturer's flow standards. The manufacturer shall provide a certificate of calibration for meter.
d. Each meter shall be programmed using project-specific application data.

e. Meter shall include integral diagnostics to verify installation conditions and proper operation.

3. Performance:

   a. Volumetric Flow Accuracy: Within 1 percent of reading for meter NPS 1 (DN 25) and larger; within 2 percent of reading for smaller sizes.
   b. Mass Flow Accuracy: Within 1.5 percent of reading for NPS 1 (DN 25) and larger; within 2.5 percent of reading for smaller sizes.
   c. Ambient Temperature: Zero to 132 deg F (Minus 18 to plus 56 deg C).
   d. Process Temperature: 25 to 464 deg F (Minus 4 to plus 240 deg C).
   e. Pressure: Equal to flange rating.

4. Output Signals:

   a. Analog Current Signal of Flow Rate:

      1) Two-wire, 4- to 20-mA dc current source.
      2) Signal capable of operating into 1000-ohm load.

   b. Digital Signal: Pulse output for flow totalization. Two wire, scaled pulse, 0.5 Hz, 100 mA at 30-V dc.

5. Operator Interface:

   a. Keypad.
   b. Digital Display: Two-line digital display of alphanumerical characters. The meter shall display flow rate, flow totalization, and temperature and support field programming of all parameters.

6. Construction:

   a. Material: Type 316L stainless steel for sizes through NPS 4 (DN 100); Type 304 stainless steel for larger sizes.
   b. Connection: Class 300 flange.
   c. Vortex Shedder: Unalloyed titanium.
   d. Shedder Seal: Nickel-plated Inconel.
   e. Enclosure:

      1) Epoxy-painted cast aluminum.
      2) Removable screw-on cover.
      3) NEMA 250, Type 4X.
      4) Electrical Connection: Screw terminals.
      5) Conduit Connection: Two, 1/2-inch ((16-mm))trade size.

7. Remote Display Module:

   a. Remote from meter.
   b. House in a NEMA 250, Type 4 enclosure.
   c. Label terminal strip for all wiring connections.
   d. 120-V ac power supply with 24-V dc output to power the flow meter.
   e. Input Signal from Meter: Analog current, 4 to 20 mA.
   f. Output Signals:

1) Analog Current Output: Two wire, 4 to 20 mA, maximum loop resistance 275 ohms.
2) Digital Output (Isolated): Solid-state dry contacts rated for 100 mA at 50-V dc.

g. Digital Display:

1) Flow rate.
2) Totalized flow.
3) Display Digits: 3.5 for flow rate and 8 for totalization.

h. Local reset of flow totalization.
i. Program and data shall be stored in nonvolatile memory in the event of power loss.

8. Upstream Flow Straightener:

a. Flow straightener where required by installation.
b. Straightener shall be wafer type, constructed of Type 304 stainless steel, designed to be installed between field-installed flanges.
c. Straightener size shall match meter size.

I. Vortex Shedding Flow Meter with Integral Pressure and Temperature Measurement:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ONICON Incorporated.
b. Spirax Sarco Limited.

2. Description:

a. Mass flow measurement corrected for density using vortex shedder body with integral piezoelectric pressure sensors and 1000-ohm platinum RTD.
b. Meter NPS 1/2 through NPS 12 (DN 15 through DN 300).
c. Each meter shall be factory calibrated at five points from Zero to 250 fps (0 to 76 m/s) and tagged accordingly against the manufacturer's flow standards. The manufacturer shall provide a certificate of calibration for meter.
d. Each meter shall be programmed using project-specific application data.
e. Meter shall include integral diagnostics to verify installation conditions and proper operation.

3. Performance:

a. Volumetric Flow Accuracy for Liquid: Within 0.75 percent of reading for Reynolds numbers 20000 and larger.
b. Volumetric Flow Accuracy for Steam and Gas: Within 1 percent of reading for Reynolds numbers 20000 and larger.
c. Mass Flow Accuracy for Steam and Gas: Within 1.5 percent of reading for Reynolds numbers 20000 and larger.
d. Repeatability: Within 0.1 percent.
e. Long-Term Stability: Within 0.1 percent per year.
f. Ambient Temperature: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
g. Process Temperature: Minus 40 to plus 464 deg F (Minus 40 to plus 240 deg C).
h. Pressure: Equal to flange rating.

4. Output Signals:

    a. Analog Current Signal of Flow Rate:

        1) Two-wire, 4- to 20-mA dc current source.
        2) Signal capable of operating into 1000-ohm load.

    b. Analog Current Signals for Pressure and Temperature: Separate 4- to 20-mA signals for gage pressure and temperature.
    c. Digital Signal:

        1) Pulse output for flow totalization. Two wire, scaled pulse, 0.5 Hz, 100 mA at 30-V dc.
        2) HART, FSK protocol.

5. Operator Interface:

    a. Keypad.
    b. Digital Display: Two-line digital display of alphanumerical characters. The meter shall display flow rate, flow totalization, pressure, temperature, and support field programming of all parameters.

6. Construction:

    a. Material: Type 316L stainless steel.
    b. Connection: Class 300 flange.
    c. Enclosure:

        1) Epoxy-painted cast aluminum.
        2) Removable screw-on cover.
        3) NEMA 250, Type 6.
        4) Electrical Connection: Screw terminals.
        5) Conduit Connection: Two, 1/2-inch ((16-mm))trade size.

7. Upstream Flow Straightener:

    a. Meter manufacturer shall provide flow straightener where required by installation to comply with manufacturer?s installation recommendations.
    b. Straightener shall be wafer type, constructed of Type 304 stainless steel, designed to be installed between field-installed flanges.
    c. Straightener size shall match meter size.

J. Vortex Shedding Flow Meter for Hazardous Environments:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Rosemount; Emerson Process Management.
    b. Spirax Sarco Limited.

2. Standard: ASME MFC-6M.
3. Description:

    a. FM Approved for hazardous environments.

1) Intrinsically safe for Class I, Division 1, Groups A, B, C, and D; Class II and III, Division 1, Groups E, F, and G.
2) Explosion-Proof for Class I, Division 1, Groups B, C, and D.
3) Dust-Ignition-Proof for Class II and III, Division 1, Groups E, F, and G.

b. Sensor shall be isolated from process and replaceable without breaking process seals.
c. Meter immune to vibration.
d. Clog-free design eliminates gaskets and ports.
e. Meter NPS 1/2 through NPS 12 (DN 15 through DN 300).
f. Each meter shall be factory calibrated and provided with a certificate of calibration.
g. Meter shall be furnished with a permanently attached stainless-steel tag.
h. Meter shall include integral diagnostics to verify proper operation.

4. Performance:

a. Flow Accuracy: Within 0.65 percent of reading plus 0.025 percent of span for Reynolds numbers 20000 and larger.
b. Repeatability: Within 0.1 percent of flow rate.
c. Long-Term Stability: Within 0.1 percent of flow rate per year.
d. Response Time: Greater of three vortex shedding cycles or 0.2 seconds.
e. Dampening: Adjustable between 0.2 to 255 seconds.
f. Ambient Temperature: Minus 58 to plus 250 deg F (Minus 50 to plus 121 deg C).
g. Humidity: Zero to 95 percent noncondensing.
h. Process Temperature: Minus 40 to plus 450 deg F (Minus 40 to plus 232 deg C).
i. Pressure: Equal to flange rating.

5. Output Signals:

a. Analog Current Signal of Flow Rate:

1) Two-wire, 4- to 20-mA dc current source.
2) Signal capable of operating into 1000-ohm load.

b. Digital Signal:

1) Pulse output for flow totalization.
2) HART protocol.

6. Digital Display: Digital display of alphanumerical characters. The meter shall display flow rate, flow totalization, percent of range, and current output.
7. Body and Flanges:

a. Material: Type 316L stainless steel.
b. Connection: ASME B16.5, Class 300 flange.
c. Enclosure:

1) Polyurethane-painted cast aluminum.
2) Removable screw-on cover.
3) NEMA 250, Type 4X.
4) Electrical Connection: Screw terminals.
5) Conduit Connection: 1/2-inch ((16-mm))trade size.

2.7 LIQUID FLOW SENSORS (PRIMARY ELEMENTS)

A. Averaging Pitot Tubes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Rosemount; Emerson Process Management.
   b. Spirax Sarco Limited.

2. Standards: ASME MFC-12M.
3. Description:

   a. Sensor shall include isolation valves and connections that are suitable for connecting to a remote pressure instrument.
   b. Sensor shall consist of high- and low-pressure plenums and be able to accommodate an integral RTD.
   c. Sensor's cross-sectional tee shape shall allow flow separation at a fixed point independent of flow rate, pressure, or temperature with a stable flow coefficient maintained over a wide range of Reynolds numbers.
   d. Sensor shape shall promote less-turbulent zones on the backside of the sensor. Individual sensing ports shall be located in this less-turbulent region to measure low pressure. Number of sensing ports shall be a function of the pipe size.
   e. High pressure shall be measured by a frontal slot design extending full length of sensor. Number of slots shall be a function of pipe size.
   f. Manufacturer shall submit on request independent testing documentation (product test reports), demonstrating compliance with specified performance.

4. Performance:

   a. Discharge Coefficient Factor: Within 0.75 percent of flow rate.
   b. Repeatability: Within 0.1 percent.
   c. Flow Turndown: 10:1.
   d. Sensor Size for Pipe Size NPS 2 through NPS 8 (DN 50 through DN 200): Minimum rod Reynolds number of 6000; probe width of 0.59 inch ((15 mm)).
   e. Sensor Size for Pipe Size NPS 6 through NPS 36 (DN 150 through DN 900): Minimum rod Reynolds number of 12500; probe width of 1.060 inch ((27 mm)).
   f. Sensor Size for Pipe Size NPS 12 through NPS 72 (DN 300 through DN 1800): Minimum rod Reynolds number of 25000; probe width of 1.953 inches (50 mm).
   g. Process Temperature Limit: 500 deg F (260 deg C).
   h. Process Pressure Limit: Equal to flange rating.

5. Construction:

   a. Sensor Surface Finish: Front surface textured for high-Reynolds-number applications to create a more turbulent boundary layer on front surface of sensor and produce a more predictable and repeatable separation of flow at edge of sensor.
   b. Sensor Material: Type 316 stainless steel.
   c. Packing Gland:

      1) Wetted Parts: Type 316 stainless steel.
      2) Packing Material: Graphite.

d. Isolation Valve: Type 316 stainless-steel full port ball valve configured to remove sensor while isolating process.
e. Flanged In-line Pipe Spool:

1) Mount sensor in a flanged section of pipe.
2) Pipe material to match adjacent pipe.
3) Flanges to match adjacent pipe.

B. Venturis:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. HCI; Hydronics Components Inc.
b. Preso Meters.

2. On request, submit independent testing documentation (product test reports), demonstrating compliance with specified performance.
3. Standard: ASME MFC-3M.
4. Performance:

a. Accuracy within 0.5 percent of measured flow throughout flow range from design to 10 percent of design flow.
b. Accuracy with five pipe diameters of straight pipe upstream and two pipe diameters downstream.
c. Size and beta ratio shall be matched with transmitter to provide accuracy of entire assembly within 1 percent of design flow rate, when the flow rate is allowed to vary between 10 to 100 percent of the design.

5. Construction:

a. One-piece bronze or brass construction with threaded connections for pipe sizes NPS 1/2 through NPS 2 ((DN 15 to DN 50)).
b. One-piece plated cast steel with flanged connections for pipe sizes NPS 2-1/2 through NPS 8 ((DN 65 to DN 200)), and fabricated steel with flanged connections for larger sizes.
c. Sensing Taps: Two, accurately located built-in sensing taps, nipples, shut-off valves, and quick connect coupling.
d. Identification Tag: Attached to each venturi with a chain and label indicating pipe size, venturi series, station identification, and meter reading at flow rate and pressure differential.
e. Use venturi with pressure differential transmitter.

C. Orifice Plates:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Rosemount; Emerson Process Management.
b. Spirax Sarco Limited.

2. Standards: ASME MFC-3M or ASME MFC-14M.
3. Performance:

a. Orifice plates shall be sharp, square-edged concentric type.
b. Shop fabricate and calibrate orifice meter runs through NPS 2 (DN 50).
c. Field fabricate orifice runs NPS 3 (DN 80) and larger.
d. Meter run piping or tubing shall be uniform internal surface, which is free of internal grooves and striations, but is not polished. Out of roundness shall not exceed 0.5 percent. A reduction of the pipe diameter or distortion caused by welding is unacceptable.
e. Size orifice plates for 100-inch wg (24.9-kPa) pressure differential, except that the absolute value of the meter range shall not exceed the absolute value of the flowing pressure.
f. Ratio of orifice diameter to actual internal pipe diameter d/B (beta) shall be between 0.70 and 0.30.
g. Locate orifice plates in horizontal or vertical lines in accordance with good metering practice.
h. Minimum upstream and downstream straight pipe shall comply with ASME Fluid Meters Research Committee Reports.

4. Construction:

a. Fabricate the orifice plate and matching companion flanges of Type 316 stainless steel.
b. Transmitter connection shall be at least NPS 1/2 (DN 15).
c. Stamp the orifice plates with the number and the orifice bore on the handle of the plate.

5. Use orifice plate with pressure differential transmitter.
6. Calibration information and calculations shall comply with either of the referenced standards for each orifice plate.

D. Segmented Wedge Flow Sensor:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Preso Meters.
b. HCI; Hydronics Components Inc.

2. Description: Pressure differential design using a segmented or segmental wedge installed in a straight section of pipe.
3. Performance:

a. Accuracy within 0.5 percent of the measured flow over flow range from design flow to 10 percent of design flow.
b. Accuracy with 10 pipe diameters of straight pipe upstream and five pipe diameters downstream.
c. Repeatability shall be within 0.2 percent over flow range.
d. Discharge coefficient shall be linear and stable throughout the flow range.
e. Determine H/ID ratios to meet specified performance.
f. Capable of bi-directional flow measurement with no degradation of performance, with flow in either direction.
g. Suitable for working pressure of 200 psig at 200 deg F (1379 kPa at 93 deg C).

4. Construction:

a. Pipe: Type 316 stainless steel with inside diameter to match adjacent pipe. Length determined by manufacturer.
b. Wedge: Type 316 stainless-steel segmented angled wedge equal on both sides.
c. Flanges: Class 150 raised face, Type 316 stainless steel.
d. Instrument Connections: NPS 1/2 (DN 15), Class 3000, Type 316 stainless-steel half couplings.
e. Identification Tag: Stamped or engraved stainless steel.

5. Use with a pressure differential transmitter.

E. Portable Meter Package for Liquid Flow Sensors:

1. Metal-reinforced-plastic carrying case.
2. Waterproof meter with nominal 6-inch (150-mm) round dial face.
3. Meter with dual rupture-proof liquid-filled bellows having integral temperature compensation.
4. Meter with external range and zero adjustment.
5. Multiple meters in package, if required to accommodate venturis with a wide range of pressure signals.
6. Two connecting hoses, 10-feet (3-m) long, with quick connect couplings compatible with venturi couplings.
7. Two brass blowdown valves with Buna-N seals and blowdown hoses.
8. Instruction book with flow versus differential curves.
9. Suitable for working pressure of 200 psig ((1380 kPa))at 200 deg F (93.3 deg C).
10. Portable meter package to connect to flow sensor without disturbing connection to pressure differential transmitter. Provide isolation valves at connections.
11. Turn over to Owner at Project completion.

2.8 LIQUID FLOW SWITCHES

A. Liquid Flow Switch (Bellows Type):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. W. E. Anderson; Dwyer Instruments, Inc
b. Spirax Sarco Limited..

2. Description:

a. Field-adjustable four-vane combinations.
b. Field-adjustable set-point adjustment screw.
c. Suitable for pipe sizes NPS 1 through NPS 8DN 25 through DN 200.
d. Switch mounted vertically in horizontal pipe.

3. Performance:

a. Flow Rate Actuation and De-actuation: Varies with vane combination and set-point adjustment.
b. Pressure Limit: 145 psig (1000 kPa).
c. Temperature Limit: 230 deg F (110 deg C).
d. Electrical Rating: 10 A resistive, 3 A conductive at 250-V ac.
e. Switch Type: SPDT snap switch.

4. Wetted Parts Construction:

    a. Bellows: Tin-bronze.
    b. Vanes: Stainless steel.
    c. Body: Forged brass.
    d. Process Connection: NPS 1 ((DN 25)).

5. Enclosure:

    a. Die-cast aluminum alloy.
    b. NEMA 250, Type 4.
    c. Electrical Connection: Cable gland with attached wire leads.

B. Liquid Flow Switch (Magnetic Type):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. W. E. Anderson; Dwyer Instruments, Inc
    b. Spirax Sarco Limited..

2. Description:

    a. Field-adjustable five-vane combinations.
    b. Suitable for pipe sizes NPS 1-1/2 through NPS 20 (DN 40 to DN 500).
    c. Mounting Suitable for Application: Switch vertically mounted in horizontal pipe, or switch horizontally mounted in vertical pipe with flow up.
    d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for hazardous-environment Class I, Groups C and D; Class II, Groups E, F, and G.

3. Performance:

    a. Flow Rate Actuation and De-actuation: Varies with vane combination.
    b. Pressure Limit: 1000 psig (6895 kPa) for brass body, 2000 psig (13790 kPa) for Type 316 stainless-steel body.
    c. Temperature Range: Minus 4 to plus 275 deg F (Minus 20 to plus 135 deg C).
    d. Electrical Rating: 10 A at 125/250-V ac.
    e. Switch Type: DPDT snap switch.

4. Wetted Parts Construction:

    a. Vanes: Type 316 stainless steel.
    b. Body: Type 316 stainless steel.
    c. Magnetic Keeper: Type 316 stainless steel.
    d. Process Connection: NPS 1-1/2 (DN 40).

5. Enclosure:

    a. Die-cast aluminum alloy.
    b. Threaded cover.
    c. NEMA 250, Type 4.
    d. Electrical Connection: Terminal block.
    e. Conduit Connection:3/4-inch (21-mm)trade size.

C. Liquid Flow Switch (Magnetic Type) for Small-Diameter Pipe:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. W. E. Anderson; Dwyer Instruments, Inc.
    b. Spirax Sarco Limited.

2. Description:

    a. Suitable for pipe sizes NPS 1/2 through NPS 2 (DN 15 through DN 50).
    b. Mounting Suitable for Application: Switch vertically mounted in horizontal pipe, or switch horizontally mounted in vertical pipe with flow up.
    c. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for hazardous-environment Class I, Groups A, B, C, and D; Class II, Groups E, F, and G.

3. Performance:

    a. Flow Rate Actuation and De-actuation: Not adjustable.
    b. Pressure Limit of Body: 1000 psig (6895 kPa) for brass, 2000 psig (13790 kPa) for Type 303 stainless-steel body.
    c. Pressure Limit of Tee: 250 psig (1724 kPa) for brass, 1000 psig (6895 kPa) for malleable iron, and 2000 psig (13790 kPa) for forged carbon steel and stainless steel.
    d. Temperature Range: Minus 4 to plus 220 deg F (Minus 20 to plus 104 deg C).
    e. Electrical Rating: 5 A at 125/250-V ac.
    f. Switch Type: DPDT snap switch.

4. Wetted Parts Construction (Lower Body):

    a. Vanes: Type 301 stainless steel.
    b. Body: Type 303 stainless steel.
    c. Magnet: Ceramic.
    d. Process Connection: NPS 1/2 (DN 15).

5. Enclosure (Upper Body):

    a. Type 303 stainless steel.
    b. NEMA 250, Type 4.
    c. Electrical Connection: Terminal block.
    d. Conduit Connection: 3/4-inch ((21-mm))trade size.

6. Integral Mounting Tee Furnished with Switch:

    a. Stainless steel.
    b. Size: Match adjacent pipe.
    c. Connection: Threaded pipe.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

D. Provide the services of an independent inspection agency to confirm that proposed mounting locations comply with requirements indicated and approved submittals.

1. Indicate dimensioned locations with mounting height for all surface-mounted products to walls and ceilings on shop drawings.
2. Do not begin installation without submittal approval of mounting location.

E. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.

F. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTRUMENT APPLICATIONS

A. Select from instrument types to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.

B. Duct-Mounted Airflow Sensors:

1. Measured Velocities 500 fpm (2.5 m/s) and Less: Thermal airflow station.
2. Measured Velocities Greater than 500 fpm (2.5 m/s): Pitot-tube airflow sensor station.

C. Damper-Mounted Airflow Sensors:

1. Measured Velocities 400 fpm (2.0 m/s) and Less: Thermal airflow station.
2. Measured Velocities Greater than 500 fpm (2.5 m/s): Pitot-tube airflow sensor station.

D. Fan-Mounted Airflow Sensors:

1. Measured Velocities 500 fpm (2.5 m/s) and Less: Thermal airflow station.
2. Measured Velocities Greater than 500 fpm (2.5 m/s): Piezometer ring fan inlet airflow sensor.

E. Airflow Switches:

1. Measured Velocities 400 fpm ((2.0 m/s))and Less: Polymer film sail switch.
2. Measured Velocities Greater than 400 fpm (2.0 m/s): Stainless-steel single-vane switch.

F. Airflow Transmitters for Use with Pitot-Tube-Type Sensors:

1. Exhaust Air Airflow: Airflow transmitter with 0.10 percent accuracy and auto-zero feature.
2. Outdoor Air Airflow: Airflow transmitter with 0.10 percent accuracy and auto-zero feature.
3. Return Air Airflow: Airflow transmitter with 0.10 percent accuracy and auto-zero feature.
4. Supply Air Airflow: Airflow transmitter with 0.10 percent accuracy and auto-zero feature.

3.3 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a <Insert value> force.

D. Install ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

F. Corrosive Environments:

1. Use products that are suitable for environment to which they will be subjected.
2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:

    a. Laboratory exhaust airstreams.
    b. Process exhaust airstreams.

3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings with a corrosive-resistant coating that is suitable for environment.
4. Where instruments are located in a corrosive environment and are not corrosive resistant from the manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.4 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.5 INSTRUMENTS, GENERAL INSTALLATION REQUIREMENTS

A. Mounting Location:

1. Rough-in: Outline instrument-mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
2. Install switches and transmitters for air and liquid flow associated with individual air-handling units and connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
3. Install liquid and steam flow switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
4. Install airflow switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
5. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
6. Install instruments in steam, liquid, and liquid-sealed-piped services below their process connection point. Slope tubing down to instrument with a slope of 3 percent.
7. Install instruments in dry gas and non-condensable-vapor piped services above their process connection point. Slope process connection lines up to instrument with a minimum slope of 3 percent.

B. Mounting Height:

1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
2. Mount switches and transmitters, located in mechanical equipment rooms and other similar space not subject to code, state, and federal accessibility requirements, within a range of 42 to 72 inches ((1050 to)1800 mm)above the adjacent floor, grade, or service catwalk or platform.

    a. Make every effort to mount at 60 inches (1500 mm).

C. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

3.6 FLOW INSTRUMENTS INSTALLATION

A. Airflow Sensors:

1. Install sensors in straight sections of duct with manufacturer-recommended straight duct upstream and downstream of sensor.
2. Installed sensors shall be accessible for visual inspection and service. Install access door(s) in duct or equipment located upstream of sensor, to allow service personnel to hand clean sensors.

B. Liquid and Steam Sensors:

1. Install sensors in straight sections of piping with manufacturer-recommended straight piping upstream and downstream of sensor.
2. Alert manufacturer where installation cannot accommodate recommended clearance, and solicit recommendations for field modifications to installation, such as flow straighteners, to improve condition.
3. Install pipe reducers for in-line sensors smaller than line size. Position reducers at distance from sensor to avoid interference and impact on accuracy.
4. Install in-line sensors with flanges or unions to provide drop-in and -out installation.

C. Liquid Flow Meters:

1. Install meters in straight sections of piping with manufacturer-recommended straight piping upstream and downstream of sensor.
2. Install pipe reducers for in-line meters smaller than line size. Install reducers at distance from meter to avoid interference and impact on accuracy.
3. Install in-line meters with flanges or unions to provide drop-in and -out installation.
4. Insertion Meters:

    a. Install system process connections full size of meter connection, but not less than NPS 1 ((DN 25)). Providebushing if required to mate to system connection.
    b. Install meter in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement.
    c. In applications where top-dead-center location is not possible due to field constraints, install meter at location along top half of pipe if acceptable by manufacturer for mounting orientation.

D. Liquid Switches:

1. Install system process connection full size of switch connection, but not less than NPS 1 ((DN 25)). Install stainless-steel bushing if required to mate switch to system connection.
2. Install switch in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement.
3. In applications where top-dead-center location is not possible due to field constraints, install switch at location along top half of pipe if switch is acceptable by manufacturer for mounting orientation.

E. Transmitters:

1. Install airflow transmitters serving an air system in a single location adjacent to or within system control panel.
2. Install liquid flow transmitters, not integral to sensors, in vicinity of sensor. Where multiple flow transmitters serving same system are located in same room, co-locate transmitters by system to provide service personnel a single and convenient location for inspection and service.

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

3.8 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.9 CHECKOUT PROCEDURES

A. Description:

1. Check out installed products before continuity tests, leak tests, and calibration.
2. Check instruments for proper location and accessibility.
3. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.

B. Flow Instrument Checkout:

1. Verify that sensors are installed correctly with respect to flow direction.
2. Verify that sensor attachment is properly secured and sealed.
3. Verify that processing tubing attachment is secure and isolation valves have been provided.
4. Inspect instrument tag against approved submittal.
5. Verify that recommended upstream and downstream distances have been maintained.

3.10 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's recommendations.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.

8. If after-calibration-indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.11 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include six 12 months' full maintenance by skilled employees of systems and equipment Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.12 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

B. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.

C. Record videos on DVD disks.

D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION 23 09 23.14

SECTION 23 09 23.19

MOISTURE INSTRUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes moisture switches, sensors, and transmitters.

B. Related Requirements:

1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 230923.19.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
2. Product description with complete technical data, performance curves, and product specification sheets.

B. Shop Drawings:

1. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Include diagrams for power, signal, and control wiring.
3. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: To include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MOISTURE SWITCHES

A. Humidistat for Duct Applications:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Honeywell.
b. Schneider Electric USA, Inc.

2. Description:

a. Two-position control.
b. Field-adjustable set point.
c. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Performance:

a. Relative Humidity Range: 15 to 95 percent.
b. Relative Humidity Differential: 5 percent.
c. Ambient Temperature: 40 to 135 deg F (4 to 57 deg C).
d. Voltage: 120-V ac.
e. Current: 7.2 FLA.
f. Switch Type: SPDT snap switch.

4. Construction:

a. Enclosure: Metal, NEMA 250, Type 1.
b. Electrical Connections: Screw terminals.

B. Humidistat for Space Applications:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Honeywell.
b. Schneider Electric USA, Inc.

2. Description:

a. Two-position control.
b. Field-adjustable set point.
c. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Performance:

a. Relative Humidity Range: 10 to 90 percent.
b. Relative Humidity Differential: 5 percent.
c. Ambient Temperature: 40 to 135 deg F (4 to 57 deg C).

d. Voltage: 24-V ac.
e. Pilot Duty: 60 VA.
f. Switch Type: SPDT snap switch.

4. Construction:

a. Enclosure: Plastic, NEMA 250, Type 1.
b. Electrical Connections: Cable, 6 inches (150 mm) long.

2.2 MOISTURE SENSORS AND TRANSMITTERS

A. Sensors and Transmitters with Digital Display:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Honeywell.
b. Vaisala.

2. Performance:

a. Accuracy including non-linearity, hysteresis, and repeatability: Within 2 percent from zero to 90 percent relative humidity and within 2.5 percent from 90 to 100 percent relative humidity when operating between 60 to 77 deg F (16 to 25 deg C).
b. Relative Humidity Range: Zero to 100 percent.
c. Factory calibrated and NIST traceable with certificate included.

3. Construction:

a. Provide housing with integral sensor for room applications.
b. Provide housing with remote sensor probe for ducted applications.

1) Duct Sensor Body: 300 series stainless steel or chrome-plated aluminum, at least 2 inches (50 mm) long for duct-mounted applications.
2) Provide sensor with cable for field installation in conduit.
3) For duct-mounted applications, thread the sensor assembly for connection to a threaded mounting flange.

c. Provide general-purpose humidity sensor unless application requires special requirements. Provide sensor with sintered stainless-steel filter for duct applications.
d. Housing shall be ABS/PC plastic or powder-coated aluminum.
e. Housing Classification: NEMA 250, Type 4 or 4X.
f. Provide housing with wall-mounting plate.

4. Output Signal: 2-wire, 4- to 20-mA output signal with a drive capacity of at least 500 ohms at 24-V dc.
5. Provide unit with a digital display of relative humidity in percent.

B. Sensor and Transmitter without Display:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Honeywell.
    b. Vaisala.

2. Performance:

    a. Accuracy including non-linearity, hysteresis, and repeatability: Within 2 percent from zero to 90 percent relative humidity and within 3 percent from 90 to 95 percent relative humidity when operating at 68 deg F (20 deg C).
    b. Relative Humidity Range:

        1) Duct: Zero to 100 percent.
        2) Space: Zero to 95 percent relative.

    c. Factory calibrated and NIST traceable with certificate included.

3. Construction for Space Applications:

    a. Housing with integral sensor.
    b. Housing shall be ABS plastic or powder-coated aluminum.
    c. Enclosure: NEMA 250, Type 4.
    d. Provide housing with a wall-mounting plate.

4. Construction for Duct and Equipment Applications:

    a. Housing with integral sensor.
    b. Duct Sensor Body: 300 series stainless steel.
    c. Provide sensor with sintered stainless-steel filter for duct applications.
    d. Housing shall be cast aluminum.
    e. Enclosure: NEMA 250, Type 4.

5. Output Signal: Two-wire, 4- to 20-mA output signal with drive capacity of at least 500 ohms at 24-V dc.

C. Sensor and Transmitter without Display:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. MAMAC Systems, Inc.
    b. Honeywell

2. Performance:

    a. Relative Humidity Range: Zero to 100 percent.
    b. Accuracy: Within 2 percent.
    c. Operating Temperatures: Minus 30 to 130 deg F (Minus 1 to 54 deg C).
    d. Hysteresis: Within 1 percent.

3. Construction:

a. Duct-type sensor for duct-mounted applications. Integral-type sensor for room or space applications.
b. Sensor Body: 300 series stainless steel, 6 inches (150 mm) long for duct-mounted applications.
c. For outdoor and duct applications, install circuitry in a NEMA 250, Type 4 or 4X enclosure.

4. Output Signal:

a. Two-wire, 4- to 20-mA output signal with a drive capacity of at least 600 ohms at 24-V dc.
b. Non-interacting zero and span adjustments.

D. Combination Humidity and Temperature Sensor and Transmitter with Display:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Honeywell.
b. Vaisala.

2. Description:

a. Factory package consisting of humidity and temperature sensor, digital display, keypad user interface, installation hardware, interconnecting sensor cabling, installation instructions, and operating manual.
b. Each transmitter shall be individually calibrated and provided with NIST traceable calibration certifications.
c. Provide a service cable for connecting to a notebook computer and Microsoft Windows compatible software.

3. Display:

a. Alphanumeric display of the following on the face of the enclosure:

1) Percent relative humidity.
2) Absolute humidity.
3) Mixing ratio.
4) Dry-bulb temperature.
5) Wet-bulb temperature.
6) Dew point temperature.
7) Enthalpy.

b. Visual display of measurement trends, and minimum and maximum values over a one-year period.

4. Electronics Enclosure:

a. Integral to sensors for wall- (room-)mounted applications and remote from temperature and humidity sensors for duct and equipment applications.
b. NEMA 250, Type 4 or 4X.
c. Labeled terminal strip for field wiring connections.
d. ?-inch ((16-mm))trade size threaded conduit connection.

5. Programming:

    a. Transmitter parameters shall be field programmable through keypad on the face of the enclosure.
    b. Programmed parameters shall be stored in nonvolatile EEPROM.

6. Output Signals:

    a. Three Analog Outputs: 4 to 20 mA or zero to 10-V dc for each output. Option to use a serial communication interface.

7. Temperature Sensor:

    a. Temperature range matched to application, but not less than minus 40 to 140 deg F (minus 40 to 60 deg C).
    b. Within 0.5 deg F (0.3 deg C) accuracy over the temperature range of 50 to 100 deg F (10 to 38 deg C) and within 1 deg F (0.6 deg C) over the remainder of the range.
    c. Provide duct installation kit for duct applications.

8. Humidity Sensor:

    a. Relative Humidity Measurement Range: Zero to 100 percent.
    b. Response time in still air within 40 seconds.
    c. Accuracy including non-linearity, hysteresis, and repeatability:

        1) For Temperature Between 59 and 77 Deg F (15 to 25 Deg C) and Relative Humidity between Zero and 90 Percent: Within 1 percent.
        2) For Temperature between 59 and 77 Deg F (15 to 25 Deg C) and Relative Humidity between 90 and 100 Percent: Within 1.7 percent.
        3) For Temperature between Minus 4 and 104 Deg F (Minus 20 to 40 Deg C): Within 1 percent plus 0.008 times relative humidity reading.
        4) For Temperature between Minus 40 and 356 Deg F (Minus 40 to 180 Deg C): Within 1.5 percent plus 0.015 times the relative humidity reading.

    d. Sintered, stainless-steel filter, protecting sensor.
    e. Provide duct installation kit for duct applications.

9. Power Supply:

    a. Field Power: 120-V ac, 60 Hz unless otherwise required by the application.
    b. Internal Power: As required by transmitter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install products level, plumb, parallel, and perpendicular with building construction.

B. Properly support instruments, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a <Insert value> force.

C. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

E. Corrosive Environments:

1. Use products that are suitable for environment to which they are subjected.
2. If possible, avoid or limit use of materials in corrosive environments.
3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
4. Where instruments are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 MOISTURE INSTRUMENTS INSTALLATION

A. Mounting Location: Rough-in instrument-mounting locations before setting instruments and routing, cable, wiring, tubing, and conduit to final location.

B. Mounting Height:

1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code, state, and Federal accessibility requirements within a range of 42 to 72 inches ((1.1 to 1.6 m))above the adjacent floor, grade, or service catwalk or platform.

    a. Make every effort to mount at 60 inches (1.5 m).

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with instrument identification on face of ceiling directly below instruments concealed above ceilings.

3.6 CHECKOUT PROCEDURES

A. Check installed products before continuity tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

3.7 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's written instructions.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.

9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.8 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include six 12 months' full maintenance by skilled employees of systems and equipment Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

B. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.

C. Record videos on DVD disks.

D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION 23 09 23.19

SECTION 23 09 23.23

PRESSURE INSTRUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Air-pressure sensors.
2. Air-pressure switches.
3. Air-pressure transmitters.
4. Liquid-pressure switches.
5. Liquid-pressure transmitters.

B. Related Requirements:

1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 23 09 93 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 23 09 23.23.

1.3 DEFINITIONS

A. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a control, asset management, safety, or other system using any control platform.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Product installation location shown in relationship to room, duct, pipe, and equipment.
2. Wall-mounted instruments located in finished space, showing relationship to light switches, fire alarm devices, and other installed devices.
3. Size and location of wall access panels for instruments installed behind walls.
4. Size and location of ceiling access panels for instruments installed in accessible ceilings.

B. Product Certificates: For each product requiring a certificate.

C. Product Test Reports: For each product requiring test performed by manufacturer and witnessed by a qualified testing agency.

D. Source quality-control reports.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:

1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

a. If instrument alone cannot comply with requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting

performance. Enclosure shall be internally insulated, electrically heated and cooled, filtered, and ventilated as required by instrument and application.

2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument-installed location shall dictate following NEMA 250 enclosure requirements:

   a. Outdoors, Protected: Type 2.
   b. Outdoors, Unprotected: Type 4X.
   c. Indoors, Heated with Filtered Ventilation: Type 1.
   d. Indoors, Heated with Nonfiltered Ventilation: Type 2.
   e. Indoors, Heated and Air-Conditioned: Type 1.
   f. Mechanical Equipment Rooms:

      1) Chiller and Boiler Rooms: Type 12.
      2) Air-Moving Equipment Rooms: Type 1.

   g. Localized Areas Exposed to Washdown: Type 4X.
   h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 3.
   i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4X.
   j. Hazardous Locations: Explosion-proof rating for condition.

2.2 AIR-PRESSURE SENSORS

A. Duct Insertion Static Pressure Sensor:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Dwyer Instruments, Inc.

2. Insertion length shall be at 8 inches (200 mm).
3. Sensor with four radial holes of 0.04-inch (1-mm) diameter.
4. Brass or stainless-steel construction.
5. Sensor with threaded end support, sealing washers and nuts.
6. Connection: NPS 1/4 (DN 6) compression fitting.
7. Suitable for flat oval, rectangular, and round duct configurations.

B. Duct Insertion Static Pressure Sensor:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. MAMAC Systems, Inc.
   b. Ebtron

2. Sensor probe with two opposing orifices designed to reduce error-associated air velocity.
3. Sensor insertion length shall be 8 inches (200 mm).
4. Construct sensor of 6061-T6 aluminum alloy or Type 304 stainless steel.

5. Connection: Threaded, NPS 1/8 (DN 6) swivel fitting for connection to copper tubing or NPS 1/4 (DN 10) barbed fitting for connection to polyethylene tubing.
6. Sensor probe attached to a mounting flange with neoprene gasket and two holes for fasteners.
7. Mounting flange shall suitable for flat oval, rectangular, and round duct configurations.
8. Pressure Rating: 10 psig (69 kPa).

C. Duct Traverse Static Pressure Sensor:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Air Monitor Corporation.
    b. Ebtron

2. Sensor shall traverse the duct cross section and have at least one pickup point every 6 inches ((150mm)) along length of sensor.
3. Construct sensor of 18-gage Type T6063-T5 extruded and anodized aluminum.
4. Sensor supported with threaded rod, sealing washer, and nut at one end and a mounting plate with gasket at other end.
5. Mounting plate with threaded, NPS 3/8 (DN 12) compression fitting for connection to tubing.
6. Accuracy within 1 percent of actual operating static pressure.
7. Dual offset static sensor design shall provide accurate sensing of duct static pressure in the presence of turbulent and rotational airflows with a maximum 30 degree yaw and pitch.
8. Suitable for velocities of 100 to 10000 fpm (0.51 to 51 m/s) and temperatures of up to 200 deg F (93 deg C).
9. Sensor air resistance shall be less than 0.1 times the velocity pressure at probe-operating velocity.
10. Suitable for flat oval, rectangular, and round duct configurations.

D. Outdoor Static Pressure Sensor:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Dwyer Instruments, Inc.
    b. Ebtron

2. Provides average outdoor pressure signal.
3. Sensor with no moving parts.
4. Kit includes sensor, vinyl tubing mounting hardware.

E. Outdoor Static Pressure Sensor:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Dwyer Instruments, Inc.
    b. Ebtron

2. Provides average outdoor pressure signal.
3. Sensor with no moving parts.
4. NEMA 250, Type 4X enclosure.

5. Pressure Connection: Brass barbed fitting for NPS 1/4 ((DN 10))tubing.
6. Conduit fitting around pressure fitting for sensor support and protection to pressure connection.

F. Outdoor Static Pressure Sensor:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Air Monitor Corporation.
    b. Ebtron

2. Sensor with no moving parts.
3. Operation not affected and impaired by rain and snow.
4. Sensing plates constructed of 0.1406-inch (3.6-mm) Type 316 stainless steel.
5. Accuracy within:

    a. 1 percent of the actual outdoor atmospheric pressure when subjected to varying horizontal radial wind velocities up to 40 mph.
    b. 2 percent of the actual outdoor atmospheric pressure while subjected to varying radial wind velocities up to 40 mph with approach angles up to 30 degrees to horizontal.
    c. 3 percent of the actual outdoor atmospheric pressure while subjected to varying radial wind velocities up to 40 mph with approach angles up to 60 degrees to horizontal.
    d. Threaded,NPS 2 (DN 50) connection.

G. Space Static Pressure Sensor for Wall Mounting:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Dwyer Instruments, Inc.
    b. Ebtron

2. 100-micron filter mounted in stainless-steel wall plate senses static pressure.
3. Wall plate provided with gasket and screws, and sized to fit standard single-gang electrical box.
4. Back of sensor plate fitted with brass barbed fitting for tubing connection.

H. Space Static Pressure Sensor for Wall Mounting:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. MAMAC Systems, Inc.
    b. Ebtron

2. White ABS plastic wall plate with integral sensing port to sense static pressure.
3. Wall plate provided with matching colored screws and sized to fit standard single-gang electrical box.
4. Back of sensor plate fitted with brass union fitting for tubing connection.
5. Pressure rating: 10 psig (69kPa).

I. Space Static Pressure Sensor for Wall Mounting:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Air Monitor Corporation.

2. Stainless-steel wall plate with perforated center arranged to sense space static pressure. Exposed surfaces are provided with brush finish.
3. Wall plate provided with screws and sized to fit standard single-gang electrical box.
4. Back of sensor plate fitted with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, and 0.125-inch (3-mm) fitting for tubing connection.
5. Performance: Within 1 percent of actual room static pressure in vicinity of sensor while being subjected to an air velocity of 1000 fpm (5.1 m/s) from a 360-degree radial source.

J. Space Static Pressure Sensor for Recessed Ceiling Mounting:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Air Monitor Corporation.
    b. Ebtron

2. Stainless-steel round plate with perforated center arranged to sense space static pressure. Exposed surfaces provided with brush finish.
3. Sensor intended for flush mount on face of ceiling with pressure chamber recessed in ceiling plenum.
4. Back of sensor plate fitted with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, and 0.125-inch (3-mm) fitting for concealed tubing connection.
5. Performance: Within 1 percent of actual room static pressure in vicinity of sensor while being subjected to an air velocity of 1000 fpm (5.1 m/s) from a 360-degree radial source.

K. Space Static Pressure Sensor for Exposed or Suspended Mounting:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Air Monitor Corporation.
    b. Ebtron

2. Performance: Within 1 percent of actual room static pressure in vicinity of sensor while being subjected to an air velocity of 1000 fpm (5.1 m/s) from a 360-degree radial source.
3. Stainless steel with perforations arranged to sense space static pressure. Exposed surfaces provided with brush finish.
4. Sensor fitted with multiple sensing ports, pressure impulse suppression chamber, and airflow shielding.
5. Surface-mounted sensor provided with solid mounting plate intended for mount to ceiling with pressure chamber exposed to view.
6. Surface-mounted sensor with 0.125-inch (3-mm) fitting for exposed tubing connection.
7. Suspended sensor intended for pendent mount with pressure chamber exposed to view.
8. Suspended sensor with NPS 1/2 (DN 15) fitting for exposed pipe or tubing connection.

2.3 AIR-PRESSURE SWITCHES

A. Air-Pressure Differential Switch:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Dwyer Instruments, Inc.
    b. Ebtron

2. Diaphragm operated to actuate an SPDT snap switch.

    a. Fan safety shutdown applications: Switch with manual reset.

3. Electrical Connections: Three-screw configuration, including one screw for common operation and two screws for field-selectable normally open or closed operation.
4. Enclosure Conduit Connection: Knock out or threaded connection.
5. User Interface: Screw-type set-point adjustment located inside removable enclosure cover.
6. High and Low Process Connections: Threaded, NPS 1/8 (DN 6).
7. Enclosure:

    a. Dry Indoor Installations: NEMA 250, Type 1.
    b. Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
    c. Hazardous Environments: Explosion proof.

8. Operating Data:

    a. Electrical Rating: 15 A at 120- to 480-V ac.
    b. Pressure Limits:

        1) Continuous: 45 inches wg (11.2 kPa).
        2) Surge: 10 psig (68.9 kPa).

    c. Temperature Limits: Minus 30 to 180 deg F (Minus 34 to 82 deg C).
    d. Operating Range: Approximately 2 times set point.
    e. Repeatability: Within 3 percent.
    f. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Air-Pressure Differential Switch with Set-Point Indicator:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Dwyer Instruments, Inc.
    b. Ebtron

2. Diaphragm operated to actuate an SPDT snap switch.
3. Electrical Connections: Three-screw configuration, including one screw for common operation and two screws for field-selectable normally open or closed operation.
4. Enclosure Conduit Connection: Knock out or threaded connection.
5. User Interface: Screw-type set-point adjustment with enclosed set-point indicator and scale.
6. High and Low Process Connections: Threaded, NPS 1/8 (DN 6).
7. Enclosure:

    a. Dry Indoor Installations: NEMA 250, Type 1.
    b. Outdoor and Wet Indoor Installations: NEMA 250, Type 4.

c. Hazardous Environments: Explosion proof.

8. Operating Data:

a. Electrical Rating: 15 A at 120- to 480-V ac.
b. Pressure Limits:

1) Continuous: 10 psig (69 kPa).
2) Surge: 25 psig (172 kPa).

c. Temperature Limits: Minus 30 to 110 deg F (Minus 34 to 43 deg C).
d. Operating Range: Approximately 2 times set point.
e. Repeatability: Within 1 percent.
f. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Air-Pressure Differential Switch with Dual Scale Adjustable Set Point:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Dwyer Instruments, Inc.
b. Ebtron

2. Diaphragm operated to actuate an SPDT snap switch.
3. Electrical Connections: Push-on screw terminals.
4. Enclosure Conduit Connection: Knock out or threaded connection.
5. User Interface: Dual scale set-point adjustment knob located inside removable enclosure cover.
6. High and Low Process Connections: Slip-on tubing connections.
7. Enclosure:

a. Dry Indoor Installations: NEMA 250, Type 13.

8. Operating Data:

a. Electrical Rating: 1.5 A at 250-V ac.
b. Pressure Limits: 40 inches wg (10 kPa)
c. Temperature Limits: Minus 4 to 185 deg F (Minus 20 to 85 deg C).
d. Operating Range: Approximately 2 times set point.

D. Air-Pressure Differential Indicating Switch:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Dwyer Instruments, Inc.
b. Ebtron

2. Combination gage with low- and high-limit switches.
3. Nominal 4-inch- (100-mm-) diameter analog indication with white dial face, graduated black markings, pointer to indicate measured value, and a separate adjustable pointer for each switch set point.
4. Switch zero and set-point tamperproof adjustment screws or knobs on the dial face.
5. Each switch used as a safety limit shall have a manual reset button local to switch.

6. Switch Type: Each set point shall have two Form C relays, DPDT.
7. Electrical Connections: Screw terminals.
8. Enclosure Conduit Connection: NPS 3/4 (DN 20) threaded connection.
9. High and Low Process Connections: Threaded, NPS 1/8 (DN 6).
10. Enclosure:

    a. Dry Indoor Installations: NEMA 250, Type 1.
    b. Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
    c. Hazardous Environments: Explosion proof.

11. Operating Data:

    a. Electrical Rating: 10 A at 120- to 240-V ac.
    b. Pressure Limits: 25 psig (172 kPa).
    c. Temperature Limits: 20 to 120 deg F (Minus 7 to 49 deg C).
    d. Operating Range: Approximately twice normal operating range unless otherwise required for application.
    e. Accuracy:

        1) 4 percent for ranges through 0.5 in. wg (125 Pa).
        2) 2 percent for ranges 1 in. wg (250 Pa) and greater.

    f. Repeatability: Within 1 percent of full scale.
    g. Switch Deadband: One pointer width and within 1 percent of full scale for each switch set point.
    h. Power Supply: 24-V ac, 50/60 Hz.
    i. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 AIR-PRESSURE TRANSMITTERS

A. Air-Pressure Differential Transmitter:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Setra System.
    b. Ebtron

2. Performance:

    a. Range: Approximately 2 times set point.
    b. Accuracy: Within 0.5 percent of the full-scale range.
    c. Hysteresis: Within 0.10 percent of full scale.
    d. Repeatability: Within 0.05 percent of full scale.
    e. Stability: Within 1 percent of span per year.
    f. Overpressure: 10 psig (69 kPa).
    g. Temperature Limits: Zero to 150 deg F (Minus 18 to 66 deg C).
    h. Compensate Temperature Limits: 40 to 150 deg F (4 to 66 deg C).
    i. Thermal Effects: 0.033 percent of full scale per degree F.
    j. Shock and vibration shall not harm the transmitter.

3. Output Signals:

a. Analog Current Signal:

1) Two-wire, 4- to 20-mA dc current source.
2) Signal capable of operating into 800-ohm load.

b. Analog Voltage Signal:

1) Three wire, zero to 10 V.
2) Minimum Load Resistance: 1000 ohms.

4. Display: Four-digit digital display with minimum 0.4-inch- (10-mm-) high numeric characters.
5. Operator Interface: Zero and span adjustments located behind cover.
6. Construction:

a. Plastic casing with removable plastic cover.
b. Threaded, NPS 1/4 (DN 10) swivel fittings for connection to copper tubing or NPS 3/16 (DN 7) barbed fittings for connection to polyethylene tubing. Fittings on bottom of instrument case.
c. Screw terminal block for wire connections.
d. Vertical plane mounting.
e. NEMA 250, Type 4.
f. Provide mounting bracket suitable for installation.

B. Air Pressure Differential Transmitter:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ashcroft Inc.
b. Ebtron

2. Performance:

a. Range: Approximately 2 times set point.
b. Accuracy: Within 0.25 percent of the span at reference temperature of 70 deg F (21 deg C).
c. Hysteresis: Within 0.02 percent of the span.
d. Repeatability: Within 0.05 percent of the calibrated span.
e. Stability: Within 0.25 percent of span per year.
f. Overpressure: 15 psig (103 kPa).
g. Temperature Limits: Minus 20 to 160 deg F (Minus 29 to 71 deg C).
h. Compensate Temperature Limits: 35 to 135 deg F (2 to 57 deg C).
i. Thermal Effects: 0.015 percent of full scale per degree F.
j. Warm-up Time: Within 5 seconds.
k. Response Time: 5 ms.
l. Shock and vibration shall not harm the transmitter.

3. Output Signals:

a. Analog Current Signal:

1) Two-wire, 4- to 20-mA dc current source.
2) Signal capable of operating into 1000-ohm load.

b. Analog Voltage Signal:

1) Three wire, zero to 6 V.
2) Minimum Load Resistance: 1000 ohms.

4. Operator Interface:

a. Zero and span adjustments within 10 percent of full span.
b. Potentiometer adjustments located on face of transmitter.

5. Construction:

a. Type 300 stainless-steel enclosure.
b. Swivel fittings for connection to copper tubing or barbed fittings for connection to polyethylene tubing. Fittings on front of instrument enclosure.
c. Screw terminal block for wire connections.
d. Vertical plane mounting.
e. NEMA 250, Type 2.
f. Mounting Bracket: Appropriate for installation.
g. Reverse wiring protected.
h. Calibrate to NIST-traceable standards and provide each transmitter with a certificate of calibration.

C. Air-Pressure Differential Transmitters for Hazardous Environments:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ashcroft Inc.
b. Ebtron

2. FM Approved for hazardous environments. Intrinsically safe for Classes I, II, and III, Divisions 1 and 2, Groups A through H.
3. Performance:

a. Range: Approximately 2 times set point.
b. Accuracy: Within 0.25 percent of the span at reference temperature of 70 degrees F.
c. Hysteresis: Within 0.02 percent of the span.
d. Repeatability: Within 0.05 percent of the calibrated span.
e. Stability: Within 0.25 percent of span per year.
f. Overpressure: 20 psig (138 kPa).
g. Temperature Limits: Minus 20 to 185 deg F (Minus 29 to 85 deg C).
h. Compensate Temperature Limits: Zero to 160 deg F (Minus 18 to 71 deg C).
i. Thermal Effects: 0.01 percent of full scale per degree F.
j. Warm-up Time: Within 5 seconds.
k. Response Time: 8 ms.
l. Shock and vibration shall not harm the transmitter.

4. Output Signals:

a. Analog Current Signal:

1) Two-wire, 4- to 20-mA dc current source.
2) Signal capable of operating into 1000-ohm load.

b. Analog Voltage Signal:

1) Three wire, zero to 6 V.
2) Minimum Load Resistance: 1000 ohms.

5. Operator Interface:

a. Zero and span adjustments within 10 percent of full span.
b. Potentiometer adjustments located on face of transmitter.

6. Construction:

a. Type 300 stainless-steel enclosure.
b. Swivel fittings for connection to tubing. Fittings on bottom of instrument enclosure.
c. Two 1/2-inch (16-mm) trade size conduit connections isolated from electronics.
d. Screw terminal block for wire connections.
e. Vertical plane mounting.
f. NEMA 250, Type 4X.
g. Mounting Bracket: Appropriate for installation.

7. Reverse wiring protected.
8. Calibrate to NIST-traceable standards and provide each transmitter with a certificate of calibration.

D. Air-Pressure Differential Indicating Transmitter:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Dwyer Instruments, Inc.
b. Ebtron

2. Performance:

a. Range: Approximately 2 times set point.
b. Accuracy Including Hysteresis and Repeatability: Within 1 percent of full scale at 77 deg F (25 deg C).
c. Stability: Within 1 percent of full scale per year.
d. Overpressure: 10 psig (69 kPa).
e. Temperature Limits: 20 to 120 deg F (Minus 7 to 49 deg C).
f. Thermal Effects: 0.055 percent of full scale per degree F.

3. Display: Four-digit digital display with minimum 0.4-inch- ((10-mm-))high numeric characters.
4. Operator Interface:

a. Zero and span adjustments.
b. Selectable engineering units.

5. Analog Output Current Signal:

a. Two-wire, 4- to 20-mA dc current source.

b. Signal capable of operating into a 1200-ohm load.

6. Construction:

a. Plastic casing with clear plastic cover.
b. Integral fittings for plastic tubing connections on side of instrument case for high- and low-pressure connections.
c. Terminal block for wire connections.
d. Vertical plane mounting.
e. NEMA 250, Type 1.
f. Nominal 4-inch ((100-mm)) diameter face.
g. Mounting Bracket: Appropriate for installation.

E. Air-Pressure Differential Indicating Transmitter:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Dwyer Instruments, Inc.
b. Ebtron

2. Performance:

a. Range: Approximately 2 times set point.
b. Accuracy including hysteresis and repeatability: Within 0.25 percent of full scale.
c. Stability: Within 1 percent of full scale per year.
d. Overpressure: Varies with range. At least 1.5 times range.
e. Temperature Limits: Zeroto 140 deg F (Minus 18 to 60 deg C).
f. Compensate Temperature Limits: 20 to 120 deg F (Minus 7 to 49 deg C).
g. Thermal Effects: 0.02 percent of full scale per degree F.

3. Display: Digital with minimum 0.4-inch- (10-mm-) high numeric characters.
4. Operator Interface: Zero and span adjustments.
5. Analog Output Current Signal:

a. Two-wire, 4- to 20-mA dc current source.
b. Signal capable of operating into a 1200-ohm load.

6. Construction:

a. Plastic casing with removable clear plastic cover.
b. Integral barbed fittings for rubber or plastic tubing connections on bottom of instrument case for high- and low-pressure connections.
c. Screw terminal block for wire connections.
d. Vertical plane mounting.
e. NEMA 250, Type 4X.
f. Mounting Bracket: Appropriate for installation.

F. Air-Pressure Differential Indicating Transmitter with Field-Selectable Features:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Dwyer Instruments, Inc.
b. Ebtron

2. Field-Selectable Features:

    a. Field configurable for pressure and velocity applications through user interface.
    b. Field selectable from one of three pressure ranges both in SI (metric) and inch-pound (IP) units of measure.
    c. Select range based on application. Range shall be approximately 2 times set point.

3. Performance:

    a. Accuracy Including Hysteresis and Repeatability:

        1) Within 2 percent for 0.10 in. wg (25 Pa), 1.0 in. wg (250 Pa) and all bi-directional ranges.
        2) Within 1 percent for other ranges.

    b. Stability: Within 1 percent of full scale per year.
    c. Response Time: Adjustable 0.5- to 15-second time constant with 95 percent response within 1.5 to 45 seconds.
    d. Overpressure: 1 psig (6.9 kPa) maximum operating; 10 psig (69 kPa) burst pressure.
    e. Temperature Limits: Zero to 150 deg F (Minus 18 to 66 deg C).

4. Display: Four-digit digital display with minimum 0.4-inch- (10-mm-) high numeric characters.
5. Operator Interface:

    a. Selectable pressure ranges, where indicated.
    b. Zero and span adjustments.
    c. Selectable air velocity mode with square root function.
    d. Adjustable signal dampening

6. Analog Output Current Signal:

    a. Two-wire, 4- to 20-mA dc current source.
    b. Signal capable of operating into a 1200-ohm load.

7. Analog Output Voltage Signal:

    a. Three wire, zero to 10 V.
    b. Minimum Load Resistance: 1000 ohms.

8. Construction:

    a. Plastic casing with removable clear plastic cover.
    b. NPS 3/16 (DN 7) nominal ID plastic tubing connections on side of instrument case for high- and low-pressure connections.
    c. NPS 1/2 (DN 15) NPS threaded connection for conduit.
    d. Terminal block for wire connections.
    e. Vertical plane mounting.
    f. NEMA 250, Type 4X.
    g. Nominal 4-inch- (100-mm-) diameter face.
    h. Mounting Bracket: Appropriate for installation.

G. Air-Pressure Differential Transmitter with 0.10 Percent Accuracy and Auto Zero Feature:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Air Monitor Corporation.
    b. Ebtron

2. Description:

    a. 4- to 20-mA dc output signal.
    b. NEMA 250, Type 1 enclosure.
    c. Construct the assembly so that shock, vibration, and pressure surges of up to 1 psig (6.9 kPa) will neither harm nor affect the accuracy of the transmitter.
    d. Transmitter with automatic zeroing circuit capable of automatically readjusting the transmitter to zero at predetermined time intervals. The automatic zeroing circuit shall re-zero the transmitter to within 0.1 percent of true zero.
    e. Performance:

        1) Range: Approximately 2 times set point.
        2) Calibrated Span: Field adjustable, minus 40 percent of the range.
        3) Accuracy: Within 0.10 percent of natural span.
        4) Repeatability: Within 0.15 percent of calibrated span.
        5) Linearity: Within 0.2 percent of calibrated span.
        6) Hysteresis and deadband (combined): Less than 0.2 percent of calibrated span.

    f. Integral digital display for continuous indication of pressure differential.

H. Air-Pressure Differential Transmitter with 0.25 Percent Accuracy and Auto Zero Feature:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Air Monitor Corporation.
    b. Ebtron

2. Description:

    a. 4- to 20-mA dc output signal.
    b. NEMA 250, Type 1 enclosure.
    c. Construct assembly so shock, vibration, and pressure surges of up to 1 psig (6.9 kPa) will neither harm nor affect the accuracy of the transmitter.
    d. Transmitter with automatic zeroing circuit capable of automatically readjusting the transmitter to zero at predetermined time intervals. The automatic zeroing circuit shall re-zero transmitter to within 0.1 percent of true zero.
    e. Performance:

        1) Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
        2) Calibrated Span: Field adjustable, minus 40 percent of the range.
        3) Accuracy: Within 0.25 percent of natural span.
        4) Repeatability: Within 0.15 percent of calibrated span.
        5) Linearity: Within 0.2 percent of calibrated span.
        6) Hysteresis and deadband (combined): Less than 0.2 percent of calibrated span.

f. Integral digital display for continuous indication of pressure differential.

I. Air-Pressure Differential Indicating Transmitter, Switch, and Controller:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Dwyer Instruments, Inc.
b. Ebtron

2. Description:

a. Three-in-one instrument, including digital display, control relay switches, and a transmitter with a current output.
b. Field configurable for pressure, velocity, and volumetric flow applications through user interface.
c. Select instrument range based on application. Range shall be approximately 2 times set point.

3. Performance:

a. Accuracy Including Hysteresis and Repeatability:

1) Within 1 percent for ranges less than 5 in. wg (1250 Pa).
2) Within 0.5 percent at 77 deg F (25 deg C) for other ranges.

b. Stability: Within 1 percent per year.
c. Response Time: 250 ms.
d. Overpressure: 5 psig (34 kPa) for instrument ranges less than 50 in wg (12.5 kPa) and 9 psig (62 kPa) for 100 in. wg (25 kPa) range.
e. Temperature Limits: 32 to 140 deg F (Zero to 60 deg C).
f. Thermal Effects: 0.020 percent per degree F.
g. Warm-up Period: One hour.

4. Controller Programming through Menu Keys to Access Five Menus:

a. Security level.
b. Pressure, velocity, or flow application.
c. Engineering units.
d. K-factor for use with flow application.
e. Set-point control only; set-point and alarm operation; and alarm operation as high, low, or high/low with manual or automatic reset and delay.
f. View high and low readings.
g. Digital dampening for smoothing erratic applications.
h. Scaling of analog output to fit range and field calibration.

5. Display:

a. Digital, four-digit display with backlight, with 0.4-inch- (10-mm-) high alphanumeric characters.
b. Four indicators; two for set point and two for alarm status.

6. Operator Interface:

a. Set-point adjustment through keypad on face of instrument.

b. Zero and span adjustments accessible through menu.
c. Programming through keypad.

7. Analog Output Signal:

a. Two-wire, 4- to 20-mA dc current source.
b. Signal capable of operating into a 900-ohm load.

8. Digital Output Signal:

a. Two SPDT relays.
b. Each rated for one amp at 30-V ac or dc.

9. Construction:

a. Die cast-aluminum casing and bezel.
b. Threaded, NPS 1/8 (DN 6) connections on side and back.
c. Vertical plane mounting.
d. NEMA 250, Type 1.
e. Nominal 4-inch- (100-mm-) diameter face.
f. Mounting Bracket: Appropriate for installation.

2.5 LIQUID-PRESSURE SWITCHES

A. Liquid Gage Pressure Switch, Diaphragm Operated, Low Pressure:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Mercoid Controls: Dwyer Instruments, Inc.
b. Thermowell

2. Description:

a. Diaphragm operated to actuate an SPDT snap switch.
b. Electrical Connections: Screw terminal.
c. Enclosure Conduit Connection: Knock out or threaded connection.
d. User Interface: External screw with visual set-point adjustment.
e. Process Connection: Threaded, NPS 1/4 (DN 10).
f. Enclosure:

1) Dry Indoor Installations: NEMA 250, Type 1.
2) Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
3) Hazardous Environments: Explosion proof.

3. Operating Data:

a. Electrical Rating: 15 A at 120-V ac.
b. Pressure Limits:

1) Range 1 to 30 psig (7 to 207 kPa): 60 psig (414 kPa).
2) Range 10 to 125 psig (69 to 862 kPa): 160 psig (1103 kPa).

c. Temperature Limits: Minus 30 to 150 deg F (Minus 35 to 66 deg C).

d. Operating Range: 10 to 250 psig (69 to 862 kPa).
e. Deadband: Fixed.

4. Pressure Chamber Material: Stainless steel.
5. Diaphragm Material: Nylon or PTFE.

B. Liquid Gage Pressure Switch-Diaphragm Operated:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Mercoid Controls: Dwyer Instruments, Inc.
b. Thermowell

2. Diaphragm operated to actuate a SPDT or DPDT snap switch.
3. Electrical Connections: Screw terminal.
4. Enclosure Conduit Connection: Knock out or threaded connection.
5. User Interface: Internal hex nut set-point adjustment with enclosed set-point indicator and scale.

a. Process Connection: Threaded, NPS 1/2 (DN 15).

6. Enclosure:

a. Dry Indoor Installations: NEMA 250, Type 1, 12.
b. Outdoor and Wet Indoor Installations: NEMA 250, Type 4X with drain.
c. Hazardous Environments: Explosion proof.

7. Operating Data:

a. Electrical Rating: 15 A at 120-, 240-, and 480-V ac.
b. Pressure Limits: 1200 psig (8274 kPa).
c. Ambient Temperature Limits: Minus 30 to 180 deg F (Minus 35 to 82 deg C).
d. Process Temperature Limits: Minus 4 to 167 deg F (Minus 20 to 75 deg C).
e. Adjustable Operating Range: 20 to 250 psig (138 to 1724 kPa).
f. Deadband: Adjustable.

8. Pressure Chamber Material: brass or stainless steel.
9. Diaphragm Material: Buna-N or fluorocarbon.

C. Liquid Gage Pressure Switch-Bourdon Tube Operated:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Dwyer Instruments, Inc.
b. Thermowell

2. Description:

a. Bourdon tube operated to actuate a SPDT snap switch.
b. Provide switches used in safety limiting applications with auto reset.
c. Wetted Materials: Brass or Type 403 stainless steel or Type 316 stainless steel.
d. Electrical Connections: Screw terminal.
e. Enclosure Conduit Connection: Knock out or threaded connection.

f. User Interface: Thumbscrew set-point adjustment with enclosed set-point indicator and scale.
g. Process Connection: Threaded, NPS 1/4 (DN 10).
h. Enclosure:

1) Dry Indoor Installations: NEMA 250, Type 1.
2) Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
3) Hazardous Environments: Explosion proof.

i. Operating Data:

1) Electrical Rating: [5] [10] A at 120-V ac.
2) Pressure Limits: Equal to maximum pressure in full-scale range, but not less than system design pressure rating.
3) Temperature Limits: 180 deg F (82 deg C).
4) Operating Range: Approximately 2 times set point, but not less than system design pressure rating.
5) Deadband: Adjustable or fixed as required by application.

j. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Liquid-Pressure Differential Switch with Set-Point Indicator:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Dwyer Instruments, Inc
b. Thermowell

2. Description:

a. Brass or Type 316 stainless-steel double opposing bellows operate to actuate a SPDT snap switch.
b. Electrical Connections: Screw terminal.
c. Enclosure Conduit Connection: Knock out or threaded connection.
d. User Interface: Thumbscrew set-point adjustment with enclosed set-point indicator and scale.
e. High and Low Process Connections: Threaded, NPS 1/8 (DN 3).
f. Enclosure:

1) Dry Indoor Installations: NEMA 250, Type 1.
2) Outdoor and Wet Indoor Installations: NEMA 250, Type 4.
3) Hazardous Environments: Explosion proof.

g. Operating Data:

1) Electrical Rating: 15 A at 120- to 240-V ac.
2) Pressure Limits: At least 5 times full-scale range, but not less than system design pressure rating.
3) Temperature Limits: Minus 10 to 180 deg F (Minus 23 to 82 deg C).
4) Operating Range: Approximately 2 times set point.
5) Deadband: Adjustable or fixed as required by application.

E. Liquid-Pressure Differential Switch:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Ashcroft Inc.

2. Description:

    a. Type 316 stainless-steel double opposing bellows operate to actuate an SPDT snap switch.
    b. Wetted materials: Type 316 stainless steel.
    c. Seal: Buna-N or Viton.
    d. Electrical Connections: Screw terminal.
    e. Enclosure Conduit Connection: Knock out or threaded connection.
    f. User Interface: Thumbscrew set-point adjustment with enclosed set-point indicator and scale.
    g. High and Low Process Connections: Threaded, NPS 1/4 (DN 10).
    h. Enclosure: NEMA 250, Type 4 or 4X.
    i. Operating Data:

        1) Electrical Rating: 10 A at 120- to 240-V ac.
        2) Pressure Limits: Zero to 500 psig ((Zero to 3447 kPa).)
        3) Ambient Temperature Limits: Minus 20 to 150 deg F (Minus 29 to 66 deg C).
        4) Process Temperature Limits: 20 to 300 deg F (Minus 7 to 149 deg C).
        5) Operating Range: 2 times set point, unless otherwise required by application.
        6) Deadband: Adjustable or fixed as required by application.

    j. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 LIQUID-PRESSURE TRANSMITTERS

A. Liquid Gage Pressure Transmitter with Adjustable Span for Hazardous Environments:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Rosemount; Emerson Process Management.

2. Hazardous Classification: FM Approved for hazardous environments.

    a. Intrinsically safe for Classes I, II, and III, Divisions 1 and 2, Groups A through H.
    b. Explosion proof for Class I, Division 1, Groups B, C, and D.
    c. Dust ignition proof for Class II, Division 1, Groups E, F, and G.
    d. Dust ignition proof for Class III, Division 1.

3. Performance:

    a. Range: Minus 300 to 300 psig (Minus 2068 to 2068 kPa).
    b. Span: Field adjustable.
    c. Minimum Span: 3 psig (21 kPa).
    d. Reference Accuracy: Within 0.07 percent of span or better.
    e. Stability: Within 0.125 percent of upper range limit for 5 years.
    f. Overpressure Limits: 3626 psig (25 000 kPa).

g. Process Temperature Limits: Minus 40 to 250 deg F (Minus 40 to 121 deg C).
h. Ambient Temperature Limits: Minus 40 to 185 deg F (Minus 40 to 85 deg C).
i. Temperature Effect: Within 0.025 percent of upper range limit plus 0.125 percent of span.
j. Shock and vibration shall not harm the transmitter.

4. Analog Output Current Signal:

a. Two-wire, 4- to 20-mA dc current source.
b. Signal capable of operating into 1000-ohm load.
c. Digital signal based on HART protocol carried with current signal.
d. Dampening: Field selectable from zero to 30 seconds.

5. Operator Interface: Zero and span adjustments located behind cover.
6. Display: Digital, five-digit, two-line display with 0.4-inch- (10-mm-) high alphanumeric characters.
7. Construction:

a. Non-wetted parts of transmitter constructed of aluminum or stainless steel.
b. Enclosure with removable cover on each side.
c. Wetted parts of transmitter constructed of Type 316 stainless steel.
d. Threaded, NPS 1/2 (DN 15) process connection on bottom of instrument.
e. Drain/vent valve on process connection.
f. Two 1/2-inch (16-mm) trade size conduit connections on side of instrument enclosure.
g. Screw terminal block for wire connections.
h. NEMA 250, Type 4X.
i. Mounting Bracket: Appropriate for installation.

B. Liquid-Pressure Differential Transmitter:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Dwyer Instruments, Inc.
b. Rosemont

2. Performance:

a. Range: Approximately 2 times set point.
b. Span: Adjustable plus or minus one milliamp, noninteractive.
c. Accuracy: Within 0.25 percent of full scale.
d. Pressure: Maximum operating pressure 2.5 times range.
e. Temperature Limits: Zero to 175 deg F (Minus 18 to 79 deg C).
f. Compensate Temperature Limits: 30 to 150 deg F (Minus 1 to 66 deg C).
g. Thermal Effects: 0.02 percent of full scale per degree F.
h. Response Time: 30 to 50 ms.
i. Shock and vibration shall not harm the transmitter.

3. Analog Output Current Signal:

a. Two-wire, 4- to 20-mA dc current source.
b. Signal capable of operating into 1000-ohm load.

4. Operator Interface:

a. Zero and span adjustments located behind cover.
b. Bleed screws on side of body, two screws on low-pressure side, and one screw on high-pressure side, for air in line and pressure cavity.

5. Construction:

a. Aluminum and stainless-steel enclosure with removable cover.
b. Wetted parts of transmitter constructed of 17-4 PH or 300 Series stainless steel.
c. Threaded, NPS 1/4 (DN 10) process connections on side of instrument enclosure.
d. Knock out for 1/2-inch (16-mm) nominal conduit connection on side of instrument enclosure.
e. Screw terminal block for wire connections.
f. NEMA 250, Type 4X.
g. Mounting Bracket: Appropriate for installation.

6. Three-valve manifold. Construct manifold of brass, bronze, or stainless steel. Manifold shall have threaded, NPS 1/4 (DN 10) process connections.

2.7 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled pressure instruments, as indicated by instrument requirements. Affix standards organization's certification and label.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install products level, plumb, parallel, and perpendicular with building construction.

B. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement, sway, or a break in attachment when subjected to a <Insert value> force.

C. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not to overstress threads by using excessive force or oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

E. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

F. Corrosive Environments:

1. Use products that are suitable for environment to which they are subjected.
2. If possible, avoid or limit use of materials in corrosive environments.
3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
4. Where instruments are located in a corrosive environment and are not corrosive resistant from the manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 ELECTRICAL POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 PRESSURE INSTRUMENT INSTALLATION

A. Mounting Location:

1. Rough-in: Outline instrument-mounting locations before setting instruments and routing, cable, wiring, tubing, and conduit to final location.
2. Install switches and transmitters for air and liquid pressure associated with individual air-handling units and associated connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.

3. Install liquid and steam pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
4. Install air-pressure switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
5. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
6. Install instruments (except pressure gages) in steam, liquid, and liquid-sealed piped services below their process connection point. Slope tubing down to instrument with a slope of 2 percent.
7. Install instruments in dry gas and noncondensable vapor piped services above their process connection point. Slope process connection lines up to instrument with a minimum slope of 2 percent.

B. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

C. Duct Pressure Sensors:

1. Install sensors using manufacturer's recommended upstream and downstream distances.
2. Unless indicated on Drawings, locate sensors approximately [50] [67] [75] percent of distance of longest hydraulic run. Location of sensors shall be submitted and approved before installation.
3. Install mounting hardware and gaskets to make sensor installation airtight.
4. Route tubing from the sensor to transmitter.
5. Use compression fittings at terminations.
6. Install sensor in accordance with manufacturer's instructions.
7. Support sensor to withstand maximum air velocity, turbulence, and vibration encountered to prevent instrument failure.

D. Outdoor Pressure Sensors:

1. Install roof-mounted sensor in least-noticeable location and as far away from exterior walls as possible.
2. Locate wall-mounted sensor in an inconspicuous location.
3. Submit sensor location for approval before installation.
4. Verify signal from sensor is stable and consistent to all connected transmitters. Modify installation to achieve proper signal.
5. Route outdoor signal pipe full size of sensor connection to transmitters. Install branch connection of size required to match to transmitter.
6. Install sensor signal pipe with dirt leg and drain valve below roof penetration.
7. Insulate signal pipe with flexible elastomeric insulation as required to prevent condensation.
8. Connect roof-mounted signal pipe exposed to outdoors to building grounding system.

E. Air-Pressure Differential Switches:

1. Install air-pressure sensor in system for each switch connection. Install sensor in an accessible location for inspection and replacement.
2. A single sensor may be used to share a common signal to multiple pressure instruments.
3. Install access door in duct and equipment to access sensors that cannot be inspected and replaced from outside.
4. Route NPS 3/8 (DN 12) tubing from sensor to switch connection.

5. Do not mount switches on rotating equipment.
6. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.
7. Install switches in an easily accessible location serviceable from floor.
8. Install switches adjacent to system control panel if within 50 feet (15 m); otherwise, locate switch in vicinity of system connection.

F. Liquid-Pressure Differential Switches:

1. Where process connections are located in mechanical equipment room, install switch in convenient and accessible location near system control panel.
2. Where process connections are installed outside mechanical rooms, route processing tubing to mechanical room housing system control panel and locate switch near system control panel.
3. Where multiple switches serving same system are installed in same room, install switches by system to provide service personnel a single and convenient location for inspection and service.
4. System process tubing connection shall be full size of switch connection, but not less than NPS 1/2 (DN 15). Install stainless-steel bushing if required to mate switch to system connection.
5. Connect process tubing from point of system connection and extend to switch.
6. Install isolation valves in process tubing as close to system connection as practical.
7. Install dirt leg and drain valve at each switch connection.
8. Do not mount switches on rotating equipment.
9. Install switches in a location free from vibration, heat, moisture, or adverse effects, which could damage the switch and hinder accurate operation.
10. Install switches in an easily accessible location serviceable from floor.

G. Liquid-Pressure Transmitters:

1. Where process connections are installed in mechanical equipment room, install transmitter in convenient and accessible location near system control panel.
2. Where process connections are installed outside mechanical rooms, route processing tubing to mechanical room housing system control panel and locate transmitter near system control panel.
3. Where multiple transmitters serving same system are installed in same room, install transmitters by system to provide service personnel a single and convenient location for inspection and service.
4. System process tubing connection shall be full size of switch connection, but not less than NPS 1/2 (DN 15). Install stainless-steel bushing if required to mate switch to system connection.
5. Connect process tubing from point of system connection and extend to transmitter.
6. Install isolation valves in process tubing as close to system connection as practical.
7. Install dirt leg and drain valve at each transmitter connection.
8. Do not mount transmitters on equipment.
9. Install in a location free from vibration, heat, moisture, or adverse effects, which could damage and hinder accurate operation.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

3.6 CHECKOUT PROCEDURES

A. Check out installed products before continuity tests, leak tests, and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

3.7 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, perform a three-point calibration test for both linearity and accuracy.
4. Equipment and procedures used for calibration shall comply with instrument manufacturer's recommendations.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If, after calibration, indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of project design values.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.9 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of systems and equipment Installer. Include annual preventive maintenance, repair or replacement of worn or defective components, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

B. Coordinate pressure instrument demonstration video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.

C. Record videos on DVD disks.

D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION 23 09 23.23

SECTION 23 09 23.27

TEMPERATURE INSTRUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Air temperature sensors.
2. Combination air temperature sensors and switches.
3. Air temperature switches.
4. High-end, commercial-grade, liquid and steam temperature sensors.
5. Liquid temperature switches.
6. High-end, commercial-grade, liquid and steam temperature transmitters.

B. Related Requirements:

1. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 230923.27.

1.3 DEFINITIONS

A. HART (Highway Addressable Remote Transducer) Protocol: The global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bidirectional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from a technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.

B. RTD: Resistance temperature detector.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control

signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation operation and maintenance instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

C. Samples: For each exposed product installed in finished space.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Product installation location shown in relationship to room, duct, pipe, and equipment.
2. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices, and other installed devices.
3. Sizes and locations of wall access panels for instruments installed behind walls.
4. Sizes and locations of ceiling access panels for instruments installed in inaccessible ceilings.

B. Product Certificates: For each product requiring a certificate.

C. Product Test Reports: For each product, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Field quality-control reports.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Provide one matching product(s) in Project inventory for each unique size and type installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:

1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

a. If instrument alone cannot meet requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and cooled, filtered, and ventilated as required by instrument and application.

2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument's installed location shall dictate following NEMA 250 enclosure requirements:

a. Outdoors, Protected: Type 2.
b. Outdoors, Unprotected: Type 4X.
c. Indoors, Heated with Filtered Ventilation: Type 1.
d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
e. Indoors, Heated and Air Conditioned: Type 1.
f. Mechanical Equipment Rooms:

1) Chiller and Boiler Rooms: Type 12.
2) Air-Moving Equipment Rooms: Type 1.

g. Localized Areas Exposed to Washdown: Type 4X.
h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 3.
i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4X.
j. Hazardous Locations: Explosion-proof rating for condition.

2.2 AIR TEMPERATURE SENSORS

A. Platinum RTDs: Common Requirements:

1. 100 or 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
3. Performance Characteristics:

a. Range: Minus 50 to 275 deg F (Minus 46 to 135 deg C).
b. Interchangeable Accuracy: At 32 deg F (zero deg C) within 0.5 deg F (0.3 deg C).
c. Repeatability: Within 0.5 deg F (0.3 deg C).
d. Self-Heating: Negligible.

4. Transmitter Requirements:

a. Transmitter required for each 100-ohm RTD.
b. Transmitter optional for 1000-ohm RTD, contingent on compliance with end-to-end control accuracy.

B. Platinum RTD, Air Temperature Averaging Sensors:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Minco.

2. 1000 ohms.
3. Temperature Range: Minus 50 to 275 deg F ((Minus 45 to 135 deg C).)
4. Multiple sensors to provide average temperature across entire length of sensor.
5. Rigid probe of aluminum, brass, copper, or stainless-steel sheath.
6. Flexible probe of aluminum, brass, copper, or stainless-steel sheath and formable to a 4-inch (100-mm) radius.
7. Length: As required by application to cover entire cross section of air tunnel.
8. Enclosure: Junction box with removable cover; NEMA 250, Type 1 for indoor applications and Type 4 for outdoor applications.
9. Gasket for attachment to duct or equipment to seal penetration airtight.
10. Conduit Connection: 1/2-inch ((16-mm) trade size.)

C. Platinum RTD Outdoor Air Temperature Sensors:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Minco.
b. Honeywell International Inc

2. 1000 ohms.
3. Temperature Range: Minus 50 to 275 deg F ((Minus 45 to 135 deg C).)
4. Probe: Single-point sensor with a stainless-steel sheath.
5. Solar Shield: Stainless steel.
6. Enclosure: NEMA 250, Type 4 or 4X junction box or combination conduit and outlet box with removable cover and gasket.
7. Conduit Connection: 1/2-inch (16-mm) trade size.

D. Thermal Resistors (Thermistors): Common Requirements:

1. 10,000 ohms at 25 deg C and a temperature coefficient of 23.5 ohms/ohm/deg C.
2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
3. Performance Characteristics:

a. Range: Minus 50 to 275 deg F (Minus 46 to 135 deg C).
b. Interchangeable Accuracy: At 77 deg F (25 deg C) within 0.5 deg F (0.3 deg C).
c. Repeatability: Within 0.5 deg F (0.3 deg C).
d. Drift: Within 0.5 deg F (0.3 deg C) over 10 years.
e. Self-Heating: Negligible.

4. Transmitter optional, contingent on compliance with end-to-end control accuracy.

E. Thermistor Space Air Temperature Sensors:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Minco.
    b. Honeywell International Inc.

2. Temperature Range: Minus 50 to 212 deg F ((Minus 45 to 100 deg C).)
3. Sensor assembly shall include a temperature sensing element mounted under a flush, brushed-aluminum cover.
4. Provide a mounting plate that is compatible with the surface shape that it is mounted to and electrical box used.
5. Concealed wiring connection.

F. Space Air Temperature Sensors for Use with DDC Controllers Controlling Terminal Units:

1. 1000-ohm platinum RTD or thermistor.
2. Thermistor:

    a. Pre-aged, burned in, and coated with glass; inserted in a metal sleeve; and entire unit encased in epoxy.
    b. Thermistor drift shall be less than plus or minus 0.5 deg F (0.3 deg C) over 10 years.

3. Temperature Transmitter Requirements:

    a. Mating transmitter required with each 100-ohm RTD.
    b. Mating transmitters optional for 1000-ohm RTD and thermistor, contingent on compliance with end-to-end control accuracy.

4. Provide digital display of sensed temperature.
5. Provide sensor with local control.

    a. Local override to turn HVAC on.
    b. Local adjustment of temperature set point.
    c. Both features shall be capable of manual override through control system operator.

2.3 COMBINATION AIR TEMPERATURE SENSOR AND SWITCH

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Minco.
2. Honeywell International Inc.

B. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.

C. Combination temperature sensor and switch in same instrument.

D. Air Temperature Switch:

1. Factory preset set point of 38 deg F (3 deg C). Field-adjustable set point from 30 to 44 deg F (minus 1 to 7 deg C).
2. Responsive to coldest 12-inch ((300-mm)) section of sensor length.

3. DPST latching relay rated at 25 A and 120-V ac, with powered controller, coil, and manual rest at panel. Wire one leg to fan start circuit and other leg to signal a remote alarm.

E. Air Temperature Sensor:

1. Temperature-averaging type over sensor length. Length to be determined by installing trade to provide uniform coverage over air tunnel. Consult manufacturer for recommendations.
2. Platinum RTD with a value of 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
3. Accuracy: Within 0.9 deg F (0.5 deg C).
4. Output Signal: 4 to 20 mA for connection to remote monitoring.
5. Encase RTDs in a flexible nominal 0.375-inch- (9-mm-) diameter sheath constructed of brass.
6. Lead wires shall be 18-gage AWG copper.
7. Enclosure: NEMA 250, Type 4.

2.4 AIR TEMPERATURE SWITCHES

A. Thermostat and Switch for Low Temperature Control in Duct Applications:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Honeywell International Inc.
   b. Siemens Industry, Inc., Building Technologies Division.

2. Description:

   a. Two-position control.
   b. Field-adjustable set point.
   c. Manual reset.
   d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Performance:

   a. Operating Temperature Range: 15 to 55 deg F (Minus 9 to 13 deg C).
   b. Temperature Differential: 5 deg F (2.8 deg C), non-adjustable and additive.
   c. Enclosure Ambient Temperature: Minus 20 to 140 deg F (Minus 11 to 60 deg C).
   d. Sensing Element Maximum Temperature: 250 deg F (121 deg C).
   e. Voltage: 120-V ac.
   f. Current: 16 FLA.
   g. Switch Type: Two SPDT snap switches operate on coldest 12-inch (300-mm)section along element length.

4. Construction:

   a. Vapor-Filled Sensing Element: Nominal 20 feet (6 m)long.
   b. Dual Temperature Scale: Fahrenheit and Celsius visible on face.
   c. Set-Point Adjustment: Screw.
   d. Enclosure: Painted metal, NEMA 250, Type 1.
   e. Electrical Connections: Screw terminals.

f. Conduit Connection: 1/2-inch (16-mm) trade size.

B. Thermostat and Switch for High Temperature Control in Duct Applications:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Schneider Electric USA, Inc.
b. Honeywell International Inc.

2. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.
3. Description:

a. Two-position control.
b. Field-adjustable set point.
c. Manual reset.
d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

4. Performance:

a. Temperature Range: 100 to 160 deg F (38 to 71 deg C).
b. Temperature Differential: 5 deg F (2.8 deg C).
c. Ambient Temperature: Zero to 260 deg F (Minus 18 to 127 deg C).
d. Voltage: 120-V ac.
e. Current: 16 FLA.
f. Switch Type: SPDT snap switch.

5. Construction:

a. Sensing Element: Helical bimetal.
b. Enclosure: Metal, NEMA 250, Type 1.
c. Electrical Connections: Screw terminals.
d. Conduit Connection: 1/2-inch (16-mm) trade size.

2.5 AIR TEMPERATURE RTD TRANSMITTERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Minco.
2. Honeywell International Inc.

B. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.

C. House electronics in NEMA 250 enclosure.

1. Duct: Type 3.
2. Outdoor: Type 4X.
3. Space: Type 1.

D. Conduit Connection: 1/2-inch ((16-mm) trade size.)

E. Functional Characteristics:

1. Input:

a. 100-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.
b. 1000-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.

2. Span (Adjustable):

a. Space: 40 to 90 deg F (4 to 32 deg C).
b. Supply Air Cooling and Heating: 40 to 120 deg F (4 to 49 deg C).
c. Supply Air Cooling Only: 40 to 90 deg F (4 to 32 deg C).
d. Supply Air Heating Only: 40 to 120 deg F (4 to 49 deg C).
e. Exhaust Air: 50 to 100 deg F (10 to 38 deg C).
f. Return Air: 50 to 100 deg F (10 to 38 deg C).
g. Mixed Air: Minus 40 to 140 deg F (Minus 40 to 60 deg C).
h. Outdoor: Minus 40 to 140 deg F (Minus 40 to 60 deg C).

3. Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc .
4. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F (28 deg C).
5. Match sensor with temperature transmitter and factory calibrate together.

F. Performance Characteristics:

1. Calibration Accuracy: Within 0.1 percent of the span.
2. Stability: Within 0.2 percent of the span for at least 6 months.
3. Combined Accuracy: Within 0.5 percent.

2.6 LIQUID AND STEAM TEMPERATURE SENSORS, HIGH-END COMMERCIAL GRADE

A. RTD:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Minco.
b. Honeywell International Inc.

2. Resistance temperature sensors shall comply with IEC 60751, Class B requirements.
3. Platinum with a value of 100 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
4. Encase RTD in a Type 316 stainless-steel sheath with a 0.25-inch (8-mm) OD.
5. Provide four-wire, PTFE-insulated, nickel-coated, 22-gage, stranded copper leads.
6. Provide spring-loaded RTDs for thermowell installations.
7. Performance Characteristics:

a. Range: Minus 328 to 932 deg F (Minus 200 to 500 deg C).
b. Interchangeable Accuracy: Within 0.54 deg F (0.3 deg C) at 32 deg F (zero deg C).
c. Stability: Within 0.05 percent maximum ice-point resistance shift after 1000 hours at 752 deg F (400 deg C).

d. Hysteresis: Within 0.04 percent of range.
e. Response Time: 62.8 percent of change in 4 seconds with water flowing across sensor at 3 fps (0.9 m/s).

B. Thermowells:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Minco.

2. Stem: Straight shank formed from solid bar stock.
3. Material: Type 304 or Type 316 stainless steel.
4. Process Connection: Threaded, NPS 3/4 (DN 20)
5. Sensor Connection: Threaded, NPS 1/2 (DN 15)
6. Bore: Sized to accommodate sensor with tight tolerance between sensor and well.
7. Furnish thermowells installed in insulated pipes and equipment with an extended neck that extends beyond the face of the insulation covering.
8. Length: As required by application and pipe size.
9. Thermowells furnished with heat-transfer compound to eliminate air gap between wall of sensor and thermowell and to reduce time constant.

C. Connection Heads:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Minco.
b. Honeywell International Inc.

2. Housing: Low-copper cast-aluminum alloy, complying with NEMA 250, Type 4.
3. Terminals: Six or eight as required by sensor.
4. Conduit Connection: 1/2-inch (16-mm) trade size.
5. Sensor Connection: NPS 1/2 (DN 15).

D. Assembly: Sensor manufacturer shall furnish sensor, thermowell, and sensor connection head to provide a matched assembly.

2.7 LIQUID TEMPERATURE SWITCHES

A. Thermostat and Switch for Temperature Control in Pipe Applications:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Minco
b. Honeywell International Inc.

2. Description:

a. Two-position control.
b. Field-adjustable set point.
c. Manual reset.

d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Performance:

a. Operating Temperature Range: 65 to 200 deg F (18 to 3 deg C).
b. Temperature Differential Deadband: 5 to 30 deg F (3 to 17 deg C), adjustable.
c. Enclosure Ambient Temperature: 150 deg F (66 deg C).
d. Sensing Element Pressure Rating: 200 psig (1379 kPa).
e. Voltage: 120-V ac.
f. Current: 8 FLA.
g. Switch Type: SPDT snap switch.

4. Construction:

a. Vapor-Filled Immersion Element: Copper, nominal 3 inches (75 mm)long.
b. Temperature Scale: Fahrenheit, visible on face.
c. Set-Point Adjustment: Screw.
d. Enclosure: Painted metal, NEMA 250, Type 1.
e. Electrical Connections: Screw terminals.
f. Conduit Connection: 3/4-inch ((21-mm) trade size).

2.8 LIQUID AND STEAM TEMPERATURE TRANSMITTERS, COMMERCIAL GRADE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Minco.
2. Honeywell International Inc.

B. House electronics in NEMA 250, Type 4X enclosure.

C. Enclosure Connection: 1/2-inch (16-mm) trade size.

D. Functional Characteristics:

1. Input: 100-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, three-wire sensors.
2. Default Span (Adjustable):

a. Chilled Water: Zero to 100 deg F (Minus 18 to 38 deg C).
b. Heating Hot Water: 32 to 212 deg F ((Zero to 100 deg C)).

3. Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc.
4. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F (28 deg C).
5. Match sensor with temperature transmitter and factory calibrate together. Each matched sensor and transmitter set shall include factory calibration data traceable to NIST.

E. Performance Characteristics:

1. Calibration Accuracy: Within 0.1 percent of the span.
2. Stability: Within 0.2 percent of the span for at least 6 months.
3. Combined Accuracy: Within 0.5 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install products level, plumb, parallel, and perpendicular with building construction.

B. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a excessive force.

C. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

D. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

E. Corrosive Environments:

1. Use products that are suitable for environment to which they are subjected.
2. If possible, avoid or limit use of materials in corrosive environments.
3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
4. Where instruments are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 TEMPERATURE INSTRUMENT INSTALLATIONS

A. Mounting Location:

1. Roughing In:

a. Outline instrument mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
b. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.

1) Indicate dimensioned locations with mounting height for all surface-mounted products on Shop Drawings.
2) Do not begin installation without submittal approval of mounting location.

c. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.

2. Install switches and transmitters for air and liquid temperature associated with individual air-handling units and associated connected ductwork and piping near air-handling units co-located in air-handling unit system control panel to provide service personnel a single and convenient location for inspection and service.
3. Install liquid and steam temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
4. Install air temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
5. Mount switches and transmitters on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer's mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Special Mounting Requirements:

1. Protect products installed outdoors from solar radiation, building and wind effect with stand-offs and shields constructed of Type 316 stainless.
2. Temperature instruments having performance impacted by temperature of mounting substrate shall be isolated with an insulating barrier located between instrument and substrate to eliminate effect. Where instruments requiring insulation are located in finished space, conceal insulating barrier in a cover matching the instrument cover.

C. Mounting Height:

1. Mount temperature instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code or state and Federal accessibility requirements within a range of 42 to 72 inches ((1.1 to 1.6 m))above the adjacent floor, grade, or service catwalk or platform.

    a. Make every effort to mount at 60 inches (1500 mm).

D. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

E. Space Temperature Sensor Installation:

1. Conceal assembly in an electrical box of sufficient size to house sensor and transmitter, if provided.
2. Install electrical box with a faceplate to match sensor cover if sensor cover does not completely cover electrical box.
3. In finished areas, recess electrical box within wall.
4. In unfinished areas, electrical box may be surface mounted if electrical light switches are surface mounted. Use a cast-aluminum electric box for surface-mounted installations.
5. Align electrical box with other electrical devices such as visual alarms and light switches located in the vicinity to provide a neat and well-thought-out arrangement. Where possible, align in both horizontal and vertical axis.

F. Outdoor Air Temperature Sensor Installation:

1. Mount sensor in a discrete location facing north.
2. Protect installed sensor from solar radiation and other influences that could impact performance.
3. If required to have a transmitter, mount transmitter remote from sensor in an accessible and serviceable location indoors.

G. Single-Point Duct Temperature Sensor Installation:

1. Install single-point-type, duct-mounted, supply- and return-air temperature sensors. Install sensors in ducts with sensitive portion of the element installed in center of duct cross section and located to sense near average temperature. Do not exceed 24 inches (610 mm) in sensor length.
2. Install return-air sensor in location that senses return-air temperature without influence from outdoor or mixed air.
3. Rigidly support sensor to duct and seal penetration airtight.
4. If required to have transmitter, mount transmitter remote from sensor at accessible and serviceable location.

H. Averaging Duct Temperature Sensor Installation:

1. Install averaging-type air temperature sensor for temperature sensors located within air-handling units, similar equipment, and large ducts with air tunnel cross-sectional area of 20 sq. ft. (1.86 sq. m) and larger.
2. Install sensor length to maintain coverage over entire cross-sectional area. Install multiple sensors where required to maintain the minimum coverage.
3. Fasten and support sensor with manufacturer-furnished clips to keep sensor taut throughout entire length.

4. If required to have transmitter, mount transmitter in an accessible and serviceable location.

I. Low-Limit Air Temperature Switch Installation:

1. Install multiple low-limit switches to maintain coverage over entire cross-sectional area of air tunnel.
2. Fasten and support sensing element with manufacturer-furnished clips to keep element taut throughout entire length.
3. Mount switches outside of airstream at a location and mounting height to provide easy access for switch set-point adjustment and manual reset.
4. Install on entering side of cooling coil unless otherwise indicated on Drawings.

J. Liquid Temperature Sensor Installation:

1. Assembly shall include sensor, thermowell and connection head.
2. For pipe NPS 4 (DN 100) and larger, install sensor and thermowell length to extend into pipe between 50 to 75 percent of pipe cross section.
3. For pipe smaller than NPS 4 (DN 100):

    a. Install reducers to increase pipe size to NPS 4 ((DN 100))at point of thermowell installation.
    b. For pipe sizes NPS 2-1/2 and NPS 3 (DN 65 and DN 80), thermowell and sensor may be installed at pipe elbow or tee to achieve manufacturer-recommended immersion depth in lieu of increasing pipe size.
    c. Minimum insertion depth shall be 2-1/2 inches (65 mm).

4. Install matching thermowell.
5. Fill thermowell with heat-transfer fluid before inserting sensor.
6. Tip of spring-loaded sensors shall contact inside of thermowell.
7. For insulated piping, install thermowells with extension neck to extend beyond face of insulation.
8. Install thermowell in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement. If top dead center location is not possible due to field constraints, install thermowell at location along top half of pipe.
9. For applications with transmitters, mount transmitter remote from sensor in an accessible and serviceable location from floor service platform or catwalk.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

3.6 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.7 CHECK-OUT PROCEDURES

A. Check installed products before continuity tests, leak tests, and calibration.

B. Check temperature instruments for proper location and accessibility.

C. Verify sensing element type and proper material.

D. Verify location and length.

E. Verify that wiring is correct and secure.

3.8 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's written instructions.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.

C. Digital Signals:

1. Check digital signals using a jumper wire.

2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform according to manufacturer's written instruction.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.10 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain temperature instruments.

B. Provide a complete set of instructional videos covering each product specified and installed and showing the following:

1. Software programming.
2. Calibration and test procedures.
3. Operation and maintenance requirements and procedures.
4. Troubleshooting procedures.

C. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.

D. Record videos on DVD disks.

E. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION 23 09 23.27

SECTION 23 09 93

SEQUENCE OF OPERATIONS FOR HVAC DDC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes control sequences for DDC for HVAC systems, subsystems, and equipment.

B. Related Requirements:

1. Section 23 09 23 "DDC Systems for HVAC" for control equipment.

1.3 DEFINITIONS

A. Analog Output: Proportional output signal (zero- to 10-V dc, 4 to 20 mA).

B. Binary Output: On/off output signal or contact closure.

C. DDC: Direct digital control.

D. Digital Output: Data output that must be interpreted digitally.

1.4 ACTION SUBMITTALS

A. Product Data:

1. An instrumentation list for each controlled system. Label each element of the controlled system in table format. Show, in the table element name, type of device, manufacturer, model number, and control device product data sheet number.
2. A complete description of the operation of the control system, including sequences of operation. Include and reference a schematic diagram of the controlled system.

B. Shop Drawings:

1. Riser diagrams showing control network layout, communication protocol, and wire types.
2. Schematic diagram of each controlled system. Include all control points labeled with point names shown or listed. Show the location of control elements in the system.
3. Wiring diagram for each controlled system. Show all control elements labels. Where a control element is the same as that shown on the control system schematic, label with the same name. Label all terminals.

1.5 CHILLED WATER SYSTEM

A. On a call for cooling from any Space Sensor in the building (as determined by the BMS), the Lead chilled water pump shall start, and the associated air cooled chiller shall be enabled.

B. On a call for chiller operation, the respective chilled water pump (one per chiller) shall start and proof of chilled water flow thru the respective chiller shall occur thru the chilled water flow switch.

C. The chiller and lead chilled water pump shall be programmed thru a lead/lag sequence of operation. The pump shall be alternated on a weekly basis (adjustable). In the event that any of the lead pump fails to operate, when commanded by the BMS, then an alarm shall be sent to the BMS and a LAG pump shall be enabled.

D. After proof of flow in the chilled water piping systems for the chiller, the chiller shall be enabled in accordance with the chiller manufacturer=s recommendations.

E. Chiller shall be provided with a Bacnet interface controller on the chiller (by respective chiller manufacturer) and an interface controller by the TCC to communicate with the chiller.

F. When the outdoor air temperature drops to 34 degrees F (adjustable), the FMCS shall start the chilled water pumps as needed to prevent freezing. The chillers may remain off if the chillers are scheduled off or if a call for cooling is not required.

Primary Chilled Water System Points List:

BO Chiller – Enable
BI Chiller - Status (On/Off)
BI Chiller – Alarm
AI Chiller - Chilled Water Entering Water Temperature (CWR) (2 required)
AI Chiller - Chilled Water Leaving Water Temperature (CWS) (2 required)
BI Chiller - Chilled Water Flow Switch(Flow-Safety) (2 required)
BO Primary Chilled Water Pump - Start/Stop (3 required)
BI Primary Chilled Water Pump - Status (On/Off) (3 required)
BI Primary Chilled Water Pump – Alarm (3 required)
BO Chilled Water System - Lead/Lag
AI Outside Air Dry Bulb Temperature
AI Outside Air Wet Bulb Temperature

1.6 VARIABLE AIR VOLUME (VAV) – ROOFTOP AIR HANDLING UNIT

A. STARTUP: VAV RTU shall be started and stopped by the BMS through the local Control Panel through the HOA switch mounted in the variable frequency drive. The VFD shall be located within the AHU equipment room. One (1) Control Panel Application Specific Controllers (ASC) will be required per AHU. Spare control points in the ASC shall be for future expansion. A current sensing relay shall indicate air handling unit fan status back to local ASC and place automatic controls in operation.

B. SAFETIES: High limit thermostat in return air located at the RTU shall stop the RTU fan upon detection of temperature above its set point. A low limit thermostat in the mixed return air stream shall stop the AHU fan upon detection of temperature below its set point. A manual reset static pressure high limit sensor in the discharge duct downstream of the AHU fan shall stop the AHU fan upon detection of duct static pressure above its set point (2.5@ B adjustable). Duct mounted smoke detector(s) shall stop the AHU fan upon detection of products of

combustion (one in R.A. per IMC and one in S. A. Per NFPA). Emergency drain pan float switch shall stop the unit fan on a rise in water level in the emergency drain pan above float switch set point. Interlock fire/smoke dampers (FSD) with respective AHU and fire alarm system. AHU shall shut off and FSD shall close on actuation of smoke detector(s) (supply duct, return air, or space mounted detectors via a signal from the Fire Alarm system). Coordinate with fire alarm system contractor. Stopping the Unit fan shall de-energize the control system. The chilled water control valve(s) shall close to their respective coils. An alarm shall be sent to the workstation upon activation of any or all safety devices.

C. TEMPERATURE CONTROL: A temperature sensor in the supply duct downstream of the RTU discharge shall transmit temperature changes to the local ASC.
   1. Cooling Mode: The ASC shall modulate the chilled water control valve(s) (one per coil) to maintain discharge air temperature set point (52 degrees F B adjustable B see AHU submittals for required L.A.T. to meet scheduled capacities). One coil sensor shall be used to monitor LAT of each cooling coil. One sensor and one 3-way control valve shall be provided for each cooling coil. AHU=s with staggered or multiple coils shall be required to have multiple LAT sensors and multiple 3-way control valves, in addition to the discharge air temperature sensor located downstream of the fan section. Where multiple coils and valves are used, the coil L.A.T. shall be controlled by the coil sensor and the duct sensor shall allow reset of the coil L.A.T. to compensate for the heat gain through the fan section. All control valves shall be closed to the cooling coil when the AHU is OFF.
   2. Pre-Heating Mode (if applicable): When outside air temperature is below (36 degrees F - Adjustable), the pre heating coil shall modulate open to heat mixed return/outside air to unit set LAT. (52 Degrees – Adjustable) One coil sensor shall be used to monitor LAT of each pre-heating coil. One sensor shall be provided for each pre-heating coil. AHU=s with staggered or multiple coils shall be required to have multiple LAT sensors.

D. Space humidity shall be monitored by the ASC and initiate start-up of the chilled water system, and AHU when the space humidity rises above set point (70% RH B adjustable).

VAV Air Handling Units Point List:
(Each Unit shall have similar but independent control points)

BO	Fan/VFD - Start/Stop
BI	Fan/VFD - Status (On/Off)
BI	Fan/VFD – Alarm
AO	Chilled Water Coil - Control Valve (3-Way) (on per cooling coil)
AI	Entering Air Temperature (at AHU)
AI	Leaving Air Temperature (Cooling coil) (one per cooling coil)
AI	Leaving Air Temperature (AHU) (duct mounted on discharge side of AHU fan)
AO	Leaving Air Temperature Reset Programming
BI	Duct Static Pressure - High Limit (at unit discharge)
AI	Duct Static Pressure (VFD control) (sensor at 2/3 downstream in duct system)
BI	Entering Air Temperature - High Limit
BI	Entering Air Temperature - Low Limit
BI	Smoke Detector (AHU Shut down)(one in supply per NFPA and one in return per IMC)
AI	Space Humidity (general space humidity monitoring)(1 required per unit)
AI	Space Humidity Set point (monitoring to initiate cooling mode and / or heating mode)
BI	Smoke Damper (AHU Shutdown where required)

1.7 VAV Boxes (Cooling Only) Points Lists:

A. Cooling Mode: The VAV box cooling damper shall modulate open as the space temperature rises above the space temperature set point and close as space temperature drops below space temperature set point (74 degrees F - Adjustable).

B. VAV boxes shall close damper 100% when it's respective AHU is shutdown.

C. Provide programming to restart respective air handing unit, pumps, etc. and open box when the VAV box override button on space temperature sensor is pushed. Each VAV box override shall be programmed independently for active or inactive status per direction by owner. Active or inactive status shall be selected by the owner on an individual box basis.

D. Each VAV box shall have an independent setback control schedule. Each box shall be programmed independently as directed by the owner. Programming shall be by the TCC. Each box shall have an independent setback temperature set point. Each Space sensor shall have a programmed high and low space temperature set point range programmed by the TCC. The final range shall be as directed by the owner. When authorized and there is a call for cooling, the respective AHU shall start and be controlled to satisfy the setback cooling requirements of the space controlled by the individual VAV Box.

E. Damper position feed back shall be provided for each box for AHU duct static pressure reset programming.

VAV Boxes (cooling only) Points List:

BO Box Start/Stop
AI Cooling CFM
AO Cooling Damper Control
AI Space Temperature
AI Space Temperature Set point
AI VAV Box Leaving Air Temperature

1.8 SINGLE DUCT VAV TERMINAL BOX WITH ELECTRIC REHEAT

A. Time of Day programmed - Occupied Mode: The VAV box damper shall modulate open to the maximum scheduled CFM set point.

B. Time of day programmed - Un-Occupied Mode: The VAV box damper shall modulate open to the minimum scheduled CFM set point.

C. Time of day - Off Mode: The VAV box damper shall be 100% closed when scheduled off and/or when the respective AHU is shut down.

D. Each box shall have an independent programmed time of day control schedule. Each box shall be programmed independently as directed by the owner. Programming shall be by the TCC. Each box shall have an independent schedule of operation. Each box shall have a programmed high (maximum) and low (minimum) CFM set point programmed by the TCC. The final programming shall be as directed by the owner.

E. The VAV Box shall be controlled by the respective space temperature and space humidity sensors associated with the respective VAV Box sensors. The VAV Box shall provide minimum or maximum cooling CFM as scheduled. The VAV Box shall provide re-heat control – Hot

Water heating shall modulate as required to maintain space temperature as sensed by the respective VAV Box space temperature sensor.

F. Humidity Control: When the respective space humidity is above set point (70% RH - adjustable), the heating coil shall modulate (SCR Control) as required to maintain a VAV Box Leaving Air Temperature at Humidity Control set point (74 degrees F - Adjustable). The VAV Box shall return to the required mode of operation (Occupied, Un-Occupied, or Off) after the space humidity drops below set point (60% RH - Adjustable).

G. The VAV box CFM shall be at maximum CFM when the space is programmed to be occupied (time of day programming.

H. Damper position feed back shall be provided for each box for AHU duct static pressure reset programming.

Single Duct VAV Terminal Box With Electric Reheat Points List:

BO Box Start/Stop
AO Maximum CFM set point
AO Minimum CFM set point
AO Damper Control
AO Heating Coil (SCR Control)
AI VAV Box Leaving Air Temperature
AI Space Temperature
AI Space Temperature Set point
AI Space Humidity (From respective space Humidity Sensor)
AI Space Humidity Set point

1.9 EXHAUST FAN (Isolation Room)

A. Each Fan shall be controlled by wall switch with Pilot Light located in nurse station in location indicated on plans. BMS shall show status of fan. When fan is switched on, BMS shall reduce the associated VAV terminal by 200 CFM (or value to accomplish a minimum room negative pressure of 0.02" water gauge).

Exhaust Fan Points List:
(Each Unit shall have similar but independent control points)

BI Fan – Status (on/off)
BI Fan – Alarm
BO VAV – CFM setpoint (Adjustable)
BI Room Pressure Differential (Expressed in positive and negative values)
BI Room Status – Positive / Negative

1.10 EXHAUST FAN

A. Fan shall be controlled by the local wall switch, light switch, and/or occupancy sensor. BMS switch shall be in series with wall, light, and/or occupancy sensors to limit run time of exhaust fan(s) outside of programmed time of day schedule.

Exhaust Fan Points List:
(Each Unit shall have similar but independent control points)

BO Fan - Start/Stop
BI Fan - Status
BI Fan - Alarm

B. PRODUCTS (Not Applicable)

C. EXECUTION (Not Applicable)

END OF SECTION 23 09 93.11

SECTION 23 21 13

HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:
   1. Chilled-water piping.
   2. Makeup-water piping.
   3. Blowdown-drain piping.
   4. Air-vent piping.
   5. Safety-valve-inlet and -outlet piping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Pressure-seal fittings.
   2. Chemical treatment.

B. Delegated-Design Submittal:

   1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
   2. Locations of pipe anchors and alignment guides and expansion joints and loops.
   3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
   4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Chilled-Water Piping: 150 psig at 200 deg F.
   2. Makeup-Water Piping: 80 psig at 150 deg F.
   3. Blowdown-Drain Piping: 200 deg F.
   4. Air-Vent Piping: 200 deg F.
   5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Charlotte Pipe and Foundry Company.
      b. IPEX USA LLC.
      c. Uponor.
      d. Viega LLC.

   2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Charlotte Pipe and Foundry Company.
      b. IPEX USA LLC.
      c. NIBCO INC.

d. Spears Manufacturing Company.
e. aquatherm.

2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A.Y. McDonald Mfg. Co.
b. HART Industrial Unions, LLC.
c. Jomar Valve.
d. WATTS; A Watts Water Technologies Company.
e. Wilkins.
f. Zurn Industries, LLC.

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 150 psig.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.6 BYPASS CHEMICAL FEEDER

A. Description: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe; fittings; flanges and flange fittings; and threaded joints.

B. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
1. Schedule 40 steel pipe; welded; fittings; flanges and flange fittings

C. Makeup-water piping installed aboveground shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

E. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

F. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using [mechanically formed]tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," Section 230523.14 "Check Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/2: Maximum span, 9 feet.
4. NPS 2: Maximum span, 10 feet.
5. NPS 2-1/2: Maximum span, 11 feet.
6. NPS 3 and Larger: Maximum span, 12 feet.

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

H. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 CHEMICAL TREATMENT

A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 21 13.13

UNDERGROUND HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Cased piping system.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing hydronic piping systems with the following minimum working-pressure ratings:
   1. Chilled-Water Piping: 150 psig (1035 kPa) at 200 deg F (93 deg C).

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

   1. Conduit piping.
   2. Cased piping.
   3. Loose-fill insulation.

B. Shop Drawings: For underground hydronic piping. Signed and sealed by a professional engineer.

   1. Calculate requirements for expansion compensation for underground piping.
   2. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads, and show concrete thrust block dimensions.
   3. Show pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness.

1.5 INFORMATIONAL SUBMITTALS

A. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet (1:500) and at vertical scale of not less than 1 inch equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing hydronic piping.

B. Qualification Data: For qualified Installer.

C. Welding certificates.

D. Material Test Reports: For cased piping.

E. Source quality-control reports.

F. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31.9, "Building Services Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 CASED PIPING SYSTEM

A. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Insul-Tek Piping Systems, Inc.
b. Perma-Pipe, Inc.
c. Thermacor Process, L.P.

B. Carrier Pipe: Plastic pipe and fittings.

C. Carrier Pipe Insulation:

1. Polyurethane Foam Pipe Insulation: Rigid, cellular, high-pressure injected between carrier pipe and jacket.

a. Comply with ASTM C 591; thermal conductivity (k-value) shall not exceed 0.14 Btu x in./h x sq. ft. x deg F (0.020 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.

D. Casing: HDPE.

E. Casing accessories include the following:

1. Joint Kit: Half-shell, pourable or split insulation, casing sleeve, and shrink-wrap sleeve.
2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe.

F. Manholes: Black steel with lifting eyes.

1. Finish: Spray-applied urethane, minimum 30 mils (0.75 mm) thick.
2. Access: 30-inch- (750-mm-) diameter waterproof cover with gasket, ladder, and two 6-inch (150-mm) vents, one high and one low, extending above grade with rain caps.
3. Conduit Stub-Outs and Seals: Welded steel with drain and vent openings.
4. Sump: 12 inches (300 mm) in diameter,12 inches (300 mm) deep.
5. Floatation Anchor: Oversized bottom keyed into concrete base.

G. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

PART 3 - EXECUTION

3.1 EARTHWORK

A. See Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATION

A. Hot-Water Heating Piping:

1. Cased piping with polyurethane carrier-pipe insulation.

a. Piping Insulation Thickness: 1 inch (25 mm).

B. Chilled-Water Piping:

1. Cased piping with polyurethane carrier-pipe insulation.

a. Piping Insulation Thickness: 1 inch (25 mm).

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Remove standing water in the bottom of trench.

C. Do not backfill piping trench until field quality-control testing has been completed and results approved.

D. Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.

E. In conduits, install drain valves at low points and manual air vents at high points.

F. Install components with pressure rating equal to or greater than system operating pressure.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. See Section 230517 "Sleeves and Sleeve Seals for HVAC Piping" for sleeves and mechanical sleeve seals through exterior building walls.

J. Secure anchors with concrete thrust blocks. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

K. See Section 264200 "Cathodic Protection" for cathodic devices and connections to piping and conduit systems.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Conduit and Cased Piping Joints: Assemble sections and finish joints with pourable or split insulation and exterior jacket sleeve, and apply shrink-wrap seals.

3.5 IDENTIFICATION

A. Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic piping. Locate tapes 6 to 8 inches (150 to 200 mm) below finished grade, directly over piping. See Section 312000 "Earth Moving" for warning-tape materials and devices and their installation.

B. Install continuous trace wire on each underground piping system; CWS, CWR, HWS and HWR.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Prepare hydronic piping for testing according to ASME B31.9 and as follows:

   a. Leave joints, including welds, uninsulated and exposed for examination during test.
   b. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
   c. Use vents installed at high points to release trapped air while filling system.

2. Test hydronic piping as follows:

   a. Subject hydronic piping to hydrostatic test pressure that is not less than 1.5 times the design pressure.
   b. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.

3. Test conduit as follows:

   a. Seal vents and drains and subject conduit to 15 psig (105 kPa) for four hours with no loss of pressure. Repair leaks and retest as required.

E. Prepare test and inspection reports.

END OF SECTION 23 21 13.13

SECTION 23 21 14

HVAC CONDENSATE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:
   1. Condensate-drain piping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following:

   1. Copper Tube.

B. Delegated-Design Submittal:

   1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
   2. Locations of pipe anchors and alignment guides and expansion joints and loops.
   3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
   4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Condensate-Drain Piping: 140 deg F.

2.2 COPPER TUBE AND FITTINGS

A. DWV Copper Tubing: ASTM B 306, Type DWV.

2.3 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:
1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:
1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints .

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

M. Install shutoff valve immediately upstream of each dielectric fitting.

N. Comply with requirements specified for identifying piping.

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements specified for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4Maximum span, 7 feet; minimum rod size, 3/8 inch.

4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

D. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

END OF SECTION 23 21 14

SECTION 23 21 16

HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes special-duty valves and specialties for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Dual-temperature heating and cooling water piping.
4. Condenser-water piping.
5. Glycol cooling-water piping.
6. Makeup-water piping.
7. Condensate-drain piping.
8. Blowdown-drain piping.
9. Air-vent piping.
10. Safety-valve-inlet and -outlet piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 150 psig (1035kPa) at 200 deg F (93 deg C)
2. Chilled-Water Piping: 150 psig (kPa) at 200 deg F (93 deg C).
3. Dual-Temperature Heating and Cooling Water Piping: 150 psig (1035 kPa) at 200 deg F (93 deg C)Condenser-Water Piping: 150 psig (1035 kPa) at 200 deg F (93 deg C)Glycol Cooling-Water Piping: 150 psig (1035 kPa) at 150 deg F (66 deg C).
4. Makeup-Water Piping: 80 psig (552 kPa) at 150 deg F (66 deg C).
5. Condensate-Drain Piping: 150 deg F (66 deg C).
6. Blowdown-Drain Piping: 200 deg F (93 deg C).
7. Air-Vent Piping: 200 deg F (93 deg C).
8. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," Section 230523.14 "Check Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230923.11 "Control Valves."Section 15901 "Control Valves."

C. Plastic Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Charlotte Pipe and Foundry Company.
c. NIBCO INC.
d. WATTS.

2. Body: One-, two-, or three-piece CPVC or PVC to match piping.
3. Ball: Full-port CPVC or PVC to match piping.
4. Seats: PTFE.
5. Seals: EPDM.

6. End Connections: Socket, union, or flanged.
7. Handle Style: Tee shape.
8. CWP Rating: Equal to piping service.
9. Maximum Operating Temperature: Equal to piping service.
10. Comply with MSS SP-122.

D. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Bell & Gossett; a Xylem brand.
    b. NIBCO INC.
    c. TACO Comfort Solutions, Inc.
    d. Victaulic Company.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig (860 kPa).
10. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett; a Xylem brand.
    c. NIBCO INC.
    d. TACO Comfort Solutions, Inc.
    e. Victaulic Company.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig (860 kPa).
11. Maximum Operating Temperature: 250 deg F (121 deg C).

F. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett; a Xylem brand.

c. Victaulic Company.
d. WATTS.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: Stainless steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Armstrong Pumps, Inc.
c. WATTS.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: Stainless steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Caleffi.
b. Griswold Controls.
c. Nexus Valve, Inc.
d. NIBCO INC.
e. Tunstall Corporation.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 300 psig (2070 kPa).

9. Maximum Operating Temperature: 250 deg F (121 deg C).

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett; a Xylem brand.
    d. Hays Fluid Controls.
    e. Nexus Valve, Inc.
    f. TACO Comfort Solutions, Inc.

2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/8 (DN 6).
7. CWP Rating: 150 psig (1035 kPa).
8. Maximum Operating Temperature: 225 deg F (107 deg C).

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett; a Xylem brand.
    c. Nexus Valve, Inc.
    d. TACO Comfort Solutions, Inc.

2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/4 (DN 8).
7. CWP Rating: 150 psig (1035 kPa).
8. Maximum Operating Temperature: 240 deg F (116 deg C).

C. Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett; a Xylem brand.
    c. TACO Comfort Solutions, Inc.

2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested after taps are fabricated

and shall be labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

3. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. (379-L) unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig (860-kPa) working pressure and 250 deg F (121 deg C) maximum operating temperature.
4. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
5. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- (20-mm-) diameter gage glass, and slotted-metal glass guard.

D. [**Diaphragm**] [**Bladder**]-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett; a Xylem brand.
    d. TACO Comfort Solutions, Inc.

2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. [**Diaphragm**] [**Bladder**]: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Tangential-Type Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett; a Xylem brand.
    d. TACO Comfort Solutions, Inc.

2. Tank: Welded steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature.
3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger.
5. Blowdown Connection: Threaded.
6. Size: Match system flow capacity.

F. In-Line Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.

b. Armstrong Products, Inc.
c. Bell & Gossett; a Xylem brand.
d. TACO Comfort Solutions, Inc.

2. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
3. Maximum Working Pressure: Up to 175 psig (1207 kPa).
4. Maximum Operating Temperature: Up to 300 deg F (149 deg C).

G. Air Purgers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMTROL, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; a Xylem brand.
d. TACO Comfort Solutions, Inc.

2. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
3. Maximum Working Pressure: 150 psig (1035 kPa).
4. Maximum Operating Temperature: 250 deg F (121 deg C).

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: Stainless-steel, 20-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig (860 kPa).

B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (860 kPa).

C. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig (5170 kPa).

D. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch (20-mm) misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

F. Expansion Fittings: Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping."Section 15124 "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.

E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

F. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

G. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 23 21 16

SECTION 23 21 23

HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Close-coupled, end-suction centrifugal pumps.
3. Separately coupled, horizontally mounted, in-line centrifugal pumps.
4. Separately coupled, vertically mounted, in-line centrifugal pumps.
5. Separately coupled, base-mounted, end-suction centrifugal pumps.
6. Separately coupled, vertically mounted, turbine centrifugal pumps.
7. Automatic condensate pump units.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.5 REQUIREMENTS

A. All pumps shall meet DOE pump rating standard PEI. Pump data tag shall include PEI Rating.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps, Inc.
2. Aurora Pump; Pentair Ltd.
3. Patterson Pump Company; a Gorman-Rupp company.
4. TACO Comfort Solutions, Inc.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

C. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Single speed and rigidly mounted to pump casing with integral pump support.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Enclosure: Totally enclosed, fan cooled.

b. Enclosure Materials: Rolled steel.
c. Motor Bearings: Permanently lubricated ball bearings.
d. Unusual Service Conditions:

1) Ambient Temperature:95 degrees F.
2) Altitude: 50 feet above sea level.
3) High humidity.

e. Efficiency: Premium efficient.
f. NEMA Design: NEMA 4
g. Service Factor: 1.5

E. Capacities and Characteristics:

1. Capacity: Refer to Schedules
2. Total Dynamic Head: Refer to schedules.
3. Maximum Operating Pressure: 175 psig (1204 kPa).
4. Maximum Continuous Operating Temperature: 250 deg F (120 deg C).

2.2 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. 300-psig (2060-kPa) pressure rating, cast-iron body and end cap, pump-inlet fitting.
3. Bronze startup and bronze or stainless-steel permanent strainers.
4. Bronze or stainless-steel straightening vanes.
5. Drain plug.
6. Factory-fabricated support.

B. Triple-Duty Valve:

1. Angle or straight pattern.
2. 300-psig (2060-kPa) pressure rating, cast-iron body, pump-discharge fitting.
3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4 and HI 2.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

E. Equipment Mounting:

1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

F. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 Steam and Condensate Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check, shutoff, and throttling valves with memory stops on discharge side of pumps.

F. Install suction diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

I. Install check valve and gate or ball valve on each condensate pump unit discharge.

J. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 23 21 23

SECTION 23 25 00

HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following HVAC water-treatment systems:

1. Manual and automatic chemical-feed equipment and controls.
2. Chemical treatment test equipment.
3. Chemicals.

1.3 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. RO: Reverse osmosis.

C. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:

1. Bypass feeders.
2. Water meters.
3. Inhibitor injection timers.
4. pH controllers.
5. TSS controllers.
6. Biocide feeder timers.
7. Chemical solution tanks.
8. Injection pumps.
9. Ozone generators.
10. UV-irradiation units.
11. Chemical test equipment.
12. Chemical material safety data sheets.
13. Water softeners.
14. RO units.
15. Multimedia filters.
16. Self-cleaning strainers.

17. Replaceable bag- or cartridge-type filters.
18. Centrifugal separators.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems.

C. 1. Include plans, elevations, sections, and attachment details.

1. Include diagrams for power and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

B. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.

C. Field quality-control reports.

D. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in "Performance Requirements" Article.
2. Water Analysis: Illustrate water quality available at Project site.
3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or to the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including hot-water heating and chilled water shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TSS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
    d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
    e. Iron Bacteria: Maintain a maximum value of zero organisms/mL.

D. Steam Boiler and Steam Condensate:

1. Steam Condensate:

    a. pH: Maintain a value within 7.8 to 8.4.
    b. Total Alkalinity: Maintain a value within 5 to 50 ppm.
    c. Chemical Oxygen Demand: Maintain a maximum value of 15 ppm.
    d. Soluble Copper: Maintain a maximum value of 0.20 ppm.
    e. TSS: Maintain a maximum value of 10 ppm.
    f. Ammonia: Maintain a maximum value of 20 ppm.
    g. Total Hardness: Maintain a maximum value of 2 ppm.

2. Steam boiler operating at 15 psig (104 kPa) and less shall have the following water qualities:

    a. "OH" Alkalinity: Maintain a value within 200 to 400 ppm.
    b. TSS: Maintain a value within 600 to 3000 ppm.

3. Steam boiler operating at more than 15 psig (104 kPa) shall have the following water qualities:

   a. "OH" Alkalinity: Maintain a value within 200 to 400 ppm.
   b. TSS: Maintain a value within 600 to 1200 ppm to maximum 30 times RO water TSS.

E. Passivation for Galvanized Steel: For the first 60 days of operation.

1. pH: Maintain a value within 7 to 8.
2. Calcium Carbonate Hardness: Maintain a value within 100 to 300 ppm.
3. Calcium Carbonate Alkalinity: Maintain a value within 100 to 300 ppm.

2.3 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch (89-mm) fill opening in the top, and NPS 3/4 (DN 20) bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

1. Capacity: 5 gal. (19 L).
2. Minimum Working Pressure: 125 psig (860 kPa).

2.4 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. See Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install water-testing equipment on wall near water-chemical-application equipment.

D. Install interconnecting control wiring for chemical treatment controls and sensors.

E. Mount sensors and injectors in piping circuits.

F. Bypass Feeders: Install in closed hydronic systems, including hot-water heating and chilled water and equipped with the following:

1. Install bypass feeder in a bypass circuit around circulating pumps unless otherwise indicated on Drawings.
2. Install water meter in makeup-water supply.
3. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.
4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
5. Install a swing check on inlet after the isolation valve.

G. Install automatic chemical-feed equipment for steam boiler and steam condensate systems and include the following:

1. Install makeup-water softener.
2. Install water meter in makeup-water supply.
3. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.

    a. Pumps shall operate for timed interval when contacts close at water meter in makeup-water supply connection.

4. Install test equipment and furnish test-kit to Owner.
5. Install RO unit for makeup water.
6. Install TSS controller with sensor and bleed valves.

    a. Bleed valves shall cycle to maintain maximum TSS concentration.

7. Install inhibitor injection timer with injection pumps and solution tanks.

    a. Pumps shall operate for timed interval on contact closure at water meter in makeup-water supply connection. Injection pump shall discharge into main steam supply header.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Section 232113 "Hydronic Piping."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."

E. See Section 221119 "Domestic Water Piping Specialties" for backflow preventers required in makeup-water connections to potable-water systems.

F. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.

G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC system's startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.

C. Equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare test report advising Owner of changes necessary to adhere to "Performance Requirements" Article for each required characteristic. Sample boiler water at six-week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.

F. At six-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to "Performance Requirements" Article.

G. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.
2. Steam System: ASTM D 1066.

3. Acidity and Alkalinity: ASTM D 1067.
4. Iron: ASTM D 1068.
5. Water Hardness: ASTM D 1126.

3.5 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping heating, hot-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:

1. Initial water analysis and HVAC water-treatment recommendations.
2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. Periodic field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical analysis.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION 23 25 00

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Single-wall rectangular ducts and fittings.
   2. Single-wall round ducts and fittings.
   3. Sheet metal materials.
   4. Sealants and gaskets.
   5. Hangers and supports.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Adhesives.
   2. Sealants and gaskets.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
   2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Duct Galvanized Coating Designation: G90.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

A. Galvanized sheet metal for rectangular and round ductwork shall have a minimum gauge of 26.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   2. Tape Width: 4 inches.
   3. Sealant: Modified styrene acrylic.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: Minus 40 to plus 200 deg F.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
   10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   3. Shore A Hardness: Minimum 20.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Base: Synthetic rubber resin.
   3. Solvent: Toluene and heptane.
   4. Solids Content: Minimum 60 percent.
   5. Shore A Hardness: Minimum 60.
   6. Water resistant.
   7. Mold and mildew resistant.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements as specified for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article."

B. If ducts are not listed in the “Duct Schedule” Article then seal unlisted ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
   1. Ducts:
      a. Pressure Class: Positive 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 6.
      d. SMACNA Leakage Class for Round and Flat Oval: 3.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Ducts with a Pressure Class Higher Than **3-Inch wg**:
        1) Test representative duct sections totaling no less than **25 percent** of total installed duct area for each designated pressure class.
    b. Exhaust Ducts with a Pressure Class of **2-Inch wg or Higher**:
        1) Test representative duct sections totaling no less than **50 percent** of total installed duct area for each designated pressure class.
    c. Outdoor Air Ducts with a Pressure Class of **2-Inch wg or Higher**:
        1) Test representative duct sections totaling no less than **50 percent** of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

A. Air Balance: Comply with requirements as specified.

3.10 DUCT SCHEDULE

A. Supply Ducts:
1. Ducts Connected to Upstream of VAV boxes:
a. Pressure Class: Positive 6-inch wg.
b. Minimum SMACNA Seal Class: A.

c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

B. Supply Ducts:
1. Ducts Connected to Downstream of VAV boxes:
a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

C. Return Ducts:
1. Ducts Connected to Variable-Volume Units:
a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

D. Return Ducts:
1. Ducts Connected to Constant-Volume Units, VRF Outside Air Units and RTUs:
a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

E. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
a. Pressure Class: Negative 2-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

F. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Constant-Volume Units, VRF Outside Air Units:
a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

END OF SECTION 23 31 13

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Manual volume dampers.
2. Motorized dampers.
3. Spin Collars.
4. Fire dampers.
5. Ceiling Radiation Dampers.
6. Smoke Dampers.
7. Combination Fire and Smoke Dampers.
8. Flange connectors.
9. Turning vanes.
10. Duct-mounted access doors.
11. Flexible connectors.
12. Flexible ducts.
13. Duct accessory hardware.
14. Outside Air Intake Hoods, roof mounted.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 MANUAL VOLUME DAMPERS

A. Low-Leakage, Steel, Manual Volume Dampers:
   1. Manufacturers:
      a. Greenheck.
      b. Dace Mfg.
      c. Nailor Industries Inc.
      d. Pottorff.
      e. Ruskin Company.
   2. Comply with AMCA 500-D testing for damper rating.
   3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
   4. Suitable for horizontal or vertical applications.
   5. Frames:
      a. Hat Channel shaped.
      b. 0.031-inch- thick, galvanized sheet steel.
      c. Mitered and welded corners.
      d. Flanges for attaching to walls and flangeless frames for installing in ducts.
   6. Blades:
      a. Multiple blade.
      b. Opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized, roll-formed steel, 0.031 inch thick.
   7. Blade Axles: Galvanized steel.
   8. Bearings:
      a. Molded synthetic.
      b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   9. Blade Seals: Neoprene.
   10. Jamb Seals: Stainless Steel.
   11. Tie Bars and Brackets: Galvanized steel.
   12. Accessories:
      a. Include locking device to hold single-blade dampers in a fixed position without vibration.

B. Jackshaft:
   1. Size: 0.5-inch diameter.
   2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
   3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 MOTORIZED DAMPERS

A. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

B. Manufacturers:
1. Greenheck.
2. Flex-Tek Group.
3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin Company.

C. For Round Duct Type, Mechanical Contractor shall furnish and install motorized dampers at outdoor intakes as indicated on mechanical and architectural drawings. Damper shall be parallel blade motorized type equivalent to Ruskin CDRS25, Greenheck Model VCDR-53, Arrow Series 250SRD or equal. Motorized dampers shall be operated by 120/1/60 electric actuator as indicated on plans. Provide Interlock with respective air handling unit. Interlock with respective air handling unit shall be low voltage. Damper shall be complete with outboard support bearing, blade and jamb seals. Dampers shall be low - leakage type.

D. For Rectangular Duct Type, Mechanical Contractor shall furnish and install motorized dampers at outdoor intakes as indicated on mechanical and architectural drawings. Damper shall be parallel blade motorized type equivalent to Ruskin CD36/PB, Arrow Series 1770, Greenheck Model VCD-23 or equal. Motorized dampers shall be operated by 120/1/60 electric actuator as indicated on plans. Provide Interlock with respective air handling unit. Interlock with respective air handling unit shall be low voltage. Damper shall be complete with outboard support bearing, blade and jamb seals. Dampers shall be low - leakage type.

E. Frames:
1. Hat shaped.
2. 0.064-inch- thick, galvanized sheet steel.
3. Mitered and welded corners.

F. Blades:
1. Multiple blade with maximum blade width of 6 inches.
2. Opposed-blade design.
3. Galvanized-steel.
4. 0.064 inch thick single skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

G. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.

H. Bearings:
1. Molded synthetic.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

3. Thrust bearings at each end of every blade.

2.5 SPIN COLLARS

A. All round take-offs to round branch duct shall be made with factory fabricated spin-type collar fittings with balancing damper and constructed of minimum 26 ga galvanized steel. The damper shall have a raised 2" handle with a high quality locking quadrant. A 3/8" continuous rod with “U” bolts connects the damper to the rod. Nylon end bearing are required where the rod penetrates the spin collar barrel. These spin-collars shall be as manufactured by Flexmaster Model FLD-B03, Dace #26ga MSD-C03 or approved equal.

2.6 HIGH EFFICIENCY TAPS

A. All round connections to rectangular main ducts located upstream of VAV terminals shall be made with factory fabricated 45 degree low loss entry “shoe” tap fittings constructed of minimum 24 ga galvanized steel. These low loss fittings shall be as manufactured by Flexmaster Model STO, Dace #24ga STO or approved equal.

2.7 FIRE DAMPERS

A. The contractor shall furnish and install UL555 rated 1-1/2 hour fire dampers at the locations indicated on the drawings in new ducts and sound attenuators. The contractor shall provide dampers with sleeves and angle frames necessary to comply with the manufacturer's UL installation requirements. Dampers for vertical or horizontal air flow shall be provided as required.

B. Manufacturers:
1. Greenheck.
2. Flex-Tek Group.
3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin Company.

C. Fire damper shall be 100% free area and installed in wall and floor openings utilizing steel sleeves, angles, other materials and practice required to provide an installation equivalent to that utilized by the manufacturer when dampers are tested by UL555. Installation shall be in accordance with the damper manufacturer's instructions.

D. Fire damper for rectangular ductwork and transfer openings shall be Ruskin type DIBD-B, Greenheck Model DFD-150-B (Basis of Design).

E. Fire dampers for round ductwork shall be Ruskin Model DIBD-CR, Greenheck DFD-150-CR (Basis of Design).

F. All fire dampers shall be installed per N.F.P.A. and U.L. requirements. Install U.L. approved sealant around the perimeter of the angle iron support at the sleeve and the wall in accordance with U. L. recommendations.

G. All fire dampers shall meet the latest Class 1 leakage requirements.

2.8 CEILING RADIATION DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Nailor Industries Inc.
2. Pottorff.
3. Ruskin Company.

B. General Requirements:

1. Labeled according to UL 555C by an NRTL.
2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.

D. Blades: Galvanized sheet steel with refractory insulation.

E. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

F. Fire Rating: 1 hours.

2.9 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin Company.

C. http://www.specagent.com/Lookup?ulid=3450General Requirements: Label according to UL 555S by an NRTL.

D. Smoke Detector: Integral, factory wired for single-point connection.

E. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded corners.

F. Blades: Roll-formed, horizontal, interlocking, 0.063-inch- (1.6-mm) thick, galvanized sheet steel.

G. Leakage: Class I.

H. Rated pressure and velocity to exceed design airflow conditions.

I. Mounting Sleeve: Factory-installed, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

J. Damper Motors: two-position action.

K. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

L. Accessories:

1. Auxiliary switches for signaling fan control or position indication.
2. Test and reset switches, damper mounted.

2.10 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded interlocking, gusseted corners.

F. Heat-Responsive Device: Resettable, 165 deg F (74 deg C) rated, fire-closure device.

G. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.

H. Smoke Detector: Integral, factory wired for single-point connection.

I. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel.

J. Leakage: Class I.

K. Rated pressure and velocity to exceed design airflow conditions.

L. Mounting Sleeve: Factory-installed, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

M. Master control panel for use in dynamic smoke-management systems.

N. Damper Motors: two-position action.

O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

P. Accessories:

1. Auxiliary switches for signaling fan control or position indication.
2. Test and reset switches, damper mounted.

2.11 TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.12 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
   1. Door:
      a. Double wall, rectangular.
      b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
      c. Vision panel.
      d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
      e. Fabricate doors airtight and suitable for duct pressure class.
   2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
   3. Number of Hinges and Locks:
      a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
      b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
      c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
      d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.13 DUCT ACCESS PANEL ASSEMBLIES

A. Labeled according to UL 1978 by an NRTL.

B. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

C. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

D. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

E. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.14 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
   1. Minimum Weight: 24 oz./sq. yd..
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.

3. Service Temperature: Minus 50 to plus 250 deg F.

F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.15 FLEXIBLE DUCTS

A. Manufacturers:
1. Thermaflex Model M-KE
2. Flexmaster 1M

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1. (R6)

C. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
2. Non-Clamp Connectors: Liquid adhesive plus tape.

2.16 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.17 OUTSIDE AIR INTAKE HOODS (ROOF MOUNTED)

A. Furnish and install intake hoods where indicated on Plans. Intake hood shall be Shipman Model SRV-1, Greenheck Model FGI/FGR, Acme Skymaster or prior approved equivalent.

B. Each hood shall be of all extruded aluminum construction. Base and throat shall have continuous welded mitered corners. Hood and extrude structural members shall utilize stainless steel fasteners. Each hood shall have a full 360 degree perimeter opening for air flow. Hoods

shall be designed to withstand 100 mph winds. Hoods shall be furnished with hinges to swing open for access to dampers. Each hood shall be furnished with mesh insect screens and factory fabricated roof curb.

C. Intake hoods shall have a 2-to-1 ratio of hood perimeter opening to throat area to provide an inlet velocity at the hood opening not to exceed 650 feet per minute.

D. Hood shall be provided with a minimum of a 14” high roof curb.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. Upstream from duct filters.
   2. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
   3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
   4. At each change in direction and at maximum 50-foot spacing.
   5. Control devices requiring inspection.
   6. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.
   3. Head and Hand Access: 18 by 10 inches.
   4. Head and Shoulders Access: 21 by 14 inches.
   5. Body Access: 25 by 14 inches.
   6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with draw bands.

P. Install duct test holes where required for testing and balancing purposes.

Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
   2. Inspect locations of access doors and verify that purpose of access door can be performed.
   3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
   4. Inspect turning vanes for proper and secure installation.
   5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Centrifugal roof ventilators.

1.3 PERFORMANCE REQUIREMENTS

A. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Roof curbs.
   7. Fan speed controllers.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers:
   1. Cook.
   2. Greenheck.
   3. ACME
   4. Pen-Barry
   5. Twin City

B. All exhaust fans shall be equipped with bird screen, automatic back-draft dampers, solid state speed controller (direct drive) and integral disconnect switch unless noted otherwise. Fan motors shall be of the 40 deg C ambient temperature rise type and shall be suitable for continuous duty operation.

C. Direct drive fans shall be complete with solid state speed control switch mounted on unit for balancing. Interlock with remote on/off switch.

D. Housing: Steel, lined with acoustical insulation.

E. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

F. Grille: Aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.

G. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Install units with clearances for service and maintenance.

C. Label units according to requirements specified.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment.

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Replace fan and motor pulleys as required to achieve design airflow.

D. Lubricate bearings.

END OF SECTION 23 34 23

SECTION 23 36 00

AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Shutoff, single-duct air terminal units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of air terminal unit.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For air terminal units.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Materials, fabrication, assembly, and spacing of hangers and supports.
2. Include design calculations for selecting hangers and supports and seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Size and location of initial access modules for acoustic tile.

3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Instructions for resetting minimum and maximum air volumes.
b. Instructions for adjusting software set points.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan-Powered-Unit Filters: Furnish one spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

2.2 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Price Industries.
2. Titus.

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 0.040-inch- (1.0-mm-) thick galvanized steel, Double wall with 1” closed cell elastomeric insulation between solid walls.

1. Casing Liner: Comply with requirements in "Casing Liner" Article for flexible elastomeric duct liner.
2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections, size matching inlet size.
4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from zero to 140 deg F (minus 18 to plus 60 deg C), shall be impervious to moisture and fungus, shall be suitable for 10-inch wg (2500-Pa) static pressure, and shall be factory tested for leaks.

E. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: AHRI 880 rated, [**2**] [**3**] percent of nominal airflow at [**3-inch wg (750-Pa)**] [**6-inch wg (1500-Pa)**] inlet static pressure.
2. Damper Position: Normally closed.

F. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. Stage(s): 2.
2. SCR controlled.
3. Access door interlocked disconnect switch.
4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
5. Nickel chrome 80/20 heating elements.
6. Airflow switch for proof of airflow.
7. Fan interlock contacts.
8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
9. Mercury contactors.
10. Pneumatic-electric switches and relays.

G. Control devices shall be compatible with temperature controls system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
1. Electronic Damper Actuator: 24 V, powered open, spring return.
2. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.
3. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg (1000 Pa); and shall have a multipoint velocity sensor at air inlet.
4. Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:

    a. Occupied and unoccupied operating mode.
    b. Remote reset of airflow or temperature set points.
    c. Adjusting and monitoring with portable terminal.
    d. Communication with temperature-control system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

5. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.

H. Controls:

1. Suitable for operation with duct pressures between 0.25- and 3.0-inch wg (60- and 750-Pa) inlet static pressure.
2. System-powered, wall-mounted thermostat.

I. Control Sequences:

1. Occupied:

a. In a call for cooling, airflow will increase as the damper opens towards maximum setting to satisfy set point.
b. In a call for less cooling, airflow will decrease as the damper closes towards minimum setting to satisfy set point.

2. Unoccupied:

a. Damper closes to minimum maximum setting.

2.3 CASING LINER

A. Casing Liner: Flexible elastomeric duct liner fabricated of preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B. Rated for use in medical / hospital applications.

1. Minimum Thickness: 3/4 inch (19 mm).
2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

a. Adhesive VOC Content: 50 g/L or less.
b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to AHRI 880.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.2 TERMINAL UNIT INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Install wall-mounted thermostats.

3.3 CONNECTIONS

A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.

B. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Comply with requirements in Section 23 31 13 "Metal Ducts" for connecting ducts to air terminal units.

D. Make connections to air terminal units with flexible connectors complying with requirements in Section 23 33 00 "Air Duct Accessories."

3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air terminal unit will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 23 36 00

SECTION 23 37 13

DIFFUSERS, REGISTERS, GRILLES, AND LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Rectangular and square ceiling diffusers.
   2. Louvered face diffuser.
   3. Continuous Tubular Diffuser (Fabric Duct)
   4. Fixed face registers and grilles.
   5. Louvers.

B. Related Sections:
   1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:
   1. Manufacturers:
      a. Titus.
      b. Price Industries.
      c. Nailor Industries.
      d. Metalaire, Inc.
   2. Devices shall be specifically designed for variable-air-volume flows.
   3. Material: Aluminum.
   4. Finish: Baked enamel, white.
   5. Face Size: 24 by 24 inches.
   6. Face Style: Three cone.

7. Mounting: T-bar.
8. Pattern: Fixed.

B. Louver Face Diffuser:
1. Material: Aluminum.
2. Finish: Baked enamel, white.
3. Face Size: See schedule on Drawings..
4. Mounting: Surface with beveled frame.
5. Pattern: Four-way core style.
6. Dampers: Radial opposed blade.
7. Accessories:
a. Square to round neck adaptor.

2.2 REGISTERS AND GRILLES

A. Fixed Face Register:
1. Manufacturers:
a. Titus.
b. Price Industries.
c. Nailor Industries.
d. Metalaire, Inc.
2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Core Construction: Integral.
5. Frame: 1 inch wide.
6. Mounting: Lay in.

2.3 LOUVERS

A. Provide louvers as scheduled in Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final

locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 235123

GAS VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Listed double-wall vents.

B. Related Requirements:

1. Section 235113.11 "Draft Control Fans" for draft inducer fans, venturi-draft inducer fans, mechanical-draft vent fans, vent exhaust fans, and combustion-air fans.
2. Section 235113.16 "Vent Dampers" for motorized and barometric dampers.
3. Section 235116 "Fabricated Breechings and Accessories" for listed, refractory-lined metal breechings and field-fabricated metal breechings.
4. Section 235133 "Insulated Sectional Chimneys" for listed chimney liners; listed building-heating-appliance chimneys; listed, refractory-lined metal chimneys; and field-fabricated chimneys.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for product.

B. Shop Drawings: For vents.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of hangers and seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents.

B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

PART 2 - PRODUCTS

2.1 LISTED TYPE B AND BW VENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Metal Products.
2. Industrial Chimney Company.
3. Metal-Fab, Inc.
4. Security Chimneys International.
5. Tru-Flex Metal Hose Corp.

B. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F (248 deg C) continuously for Type B or 550 deg F (288 deg C) continuously for Type BW; with neutral or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1/4-inch (6-mm) airspace.

D. Inner Shell: ASTM A 666, Type 430 stainless steel.

E. Outer Jacket: Aluminized steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.
2. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.
3. Termination: Exit cone with drain section incorporated into riser.
4. Termination: Antibackdraft.
5. Termination: Roof.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Type B and BW Vents: Vents for certified gas appliances.

B. Listed Type L Vent: Vents for low-heat appliances.

C. Listed Special Gas Vent: Condensing gas appliances.

3.3 INSTALLATION OF LISTED VENTS

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

B. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

C. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

D. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

E. Lap joints in direction of flow.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION 23 51 23

SECTION 23 64 23.21

AIR-COOLED SCROLL WATER CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes packaged, air-cooled, electric-motor-driven, scroll water chillers.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

C. DDC: Direct digital control.

D. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in Btu/h to the total power input given in watts at any given set of rating conditions.

E. GFI: Ground fault interrupt.

F. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit for a single chiller calculated per the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.

G. I/O: Input/output.

H. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

I. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit for a single chiller calculated per the method defined by AHRI 550/590 and intended for operating conditions other than the AHRI standard rating conditions.

J. SCCR: Short-circuit current rating.

K. TEAO: Totally enclosed air over.

L. TENV: Totally enclosed nonventilating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include refrigerant, rated capacities, operating characteristics, and furnished specialties and accessories.
2. Performance at AHRI standard conditions and at conditions indicated.
3. Performance at AHRI standard unloading conditions.
4. Minimum evaporator flow rate.
5. Refrigerant capacity of water chiller.
6. Oil capacity of water chiller.
7. Fluid capacity of evaporator.
8. Characteristics of safety relief valves.
9. Force and moment capacity of each piping connection.

B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Size and location of piping and wiring connections.
5. Diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

a. Structural supports.
b. Piping roughing-in requirements.
c. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
d. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

2. Coordination drawings showing plan, section and elevation views, drawn to ¼” scale.
3. Each view to show screened background with the following:

a. Column grids, beams, columns, and concrete housekeeping pads.
b. Layout with walls, floors, and roofs, including each room name and number.
c. Equipment and products of other trades that are located in vicinity of chillers and part of final installation, such as plumbing systems.

B. Certificates: For certification required in "Quality Assurance" Article.

C. Seismic Qualification Certificates: For water chillers, accessories, and components, from manufacturers.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Installation instructions.

E. Source quality-control reports.

F. Startup service reports.

G. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

B. Spare Parts List: Recommended spare parts list with quantity for each.

C. Touchup Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.

D. Instructional Videos: Including those that are prerecorded and those that are recorded during training.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Tool kit to include the following:

1. A tool kit specially designed by chiller manufacturer for use in servicing chiller(s) furnished.
2. Special tools required to service chiller components not readily available to Owner service personnel in performing routine maintenance.
3. Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Chiller Tool Kit." Text size shall be at least 1 inch (25 mm) high.
4. A list of each tool furnished. Permanently attach the list to underside of case cover. Text size shall be at least 1/2 inch (13 mm) high.

B. Touchup Paint: 32 oz. (1 L) container of paint used for finish coat. Label outside of container with detailed description of paint to allow for procurement of a matching paint in the future.

1.8 QUALITY ASSURANCE

A. AHRI Certification: Certify chiller according to AHRI 590 certification program.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

B. Package water chiller for export shipping.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within specified warranty period.

1. Extended warranties include, but are not limited to, the following:

a. Complete chiller including refrigerant and oil charge.
b. Complete compressor and drive assembly including refrigerant and oil charge.
c. Refrigerant and oil charge.

1) Loss of refrigerant charge for any reason due to manufacturer's product defect and product installation.

d. Parts only.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Scroll water chillers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Component Importance Factor: 1.5.

B. Site Altitude: Chiller shall be suitable for altitude at which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.

C. Performance Tolerance: Comply with the following in lieu of AHRI 550/590:

1. Allowable Capacity Tolerance: Zero percent.
2. Allowable Full-Load Energy Efficiency Tolerance: Zero percent.
3. Allowable Part-Load Energy Efficiency Tolerance: Zero percent.

D. AHRI Rating: Rate water chiller performance according to requirements in AHRI 550/590.

E. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.

F. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

G. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.

H. Comply with NFPA 70.

I. Comply with requirements of UL 1995, "Heating and Cooling Equipment," and include label by a qualified testing agency showing compliance.

J. Operation Following Loss of Normal Power:

1. Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to backup power system shall automatically return equipment and associated controls to the operating state occurring immediately before loss of normal power without need for manual intervention by an operator when power is restored either through a backup power source, or through normal power if restored before backup power is brought on-line.
2. See drawings for equipment served by backup power systems.
3. Provide means and methods required to satisfy requirement even if not explicitly indicated.

K. Outdoor Installations:

1. Chiller shall be suitable for outdoor installation indicated. Provide adequate weather protection to ensure reliable service life over a 25-year period with minimal degradation due to exposure to outdoor ambient conditions.
2. Chillers equipped to provide safe and stable operation while achieving performance indicated when operating at extreme outdoor temperatures encountered by the installation. Review historical weather database and provide equipment that can operate at extreme outdoor temperatures recorded over past 30-year period.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation; a unit of United Technologies Corp.
2. Daikin Applied.
3. Trane.
4. YORK; a Johnson Controls company.

2.3 MANUFACTURED UNITS

A. Description: Factory-assembled and run-tested water chiller complete with compressor(s), compressor motors and motor controllers, evaporator, condenser with fans, electrical power, controls, and indicated accessories.

B. Fabricate water chiller mounting base with reinforcement strong enough to resist water chiller movement during a seismic event when water chiller is anchored to field support structure.

C. Sound-reduction package shall have the following:

1. Acoustic enclosure around compressors.
2. Reduced-speed fans with acoustic treatment.
3. Designed to reduce sound level without affecting performance.

D. Security Package: Security grilles with fasteners for additional protection of compressors, evaporator, and condenser coils. Grilles shall be coated for corrosion resistance and shall be removable for service access.

2.4 CABINET

A. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.

B. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.

C. Casing: Galvanized steel.

D. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B 117.

2.5 COMPRESSOR-DRIVE ASSEMBLIES

A. Compressors:

1. Description: Positive-displacement direct drive with hermetically sealed casing.
2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.

    a. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in lieu of each compressor.

3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
4. Capacity Control: On-off compressor cycling, plus hot-gas bypass.

    a. Digital compressor unloading is an acceptable alternative to achieve capacity control.

5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug or removable magnet in sump, and initial oil charge.

    a. Manufacturer's other standard methods of providing positive lubrication are acceptable in lieu of an automatic pump.

6. Vibration Isolation: Mount individual compressors on vibration isolators.

    a. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in lieu of each compressor.

B. Compressor Motors:

1. Hermetically sealed and cooled by refrigerant suction gas.
2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

C. Compressor Motor Controllers:

1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

2.6 REFRIGERATION

A. Refrigerant: R-410A. Classified as Safety Group A1 according to ASHRAE 34.

B. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.

C. Refrigerant Circuit: Each circuit shall include an electronic-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.

D. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

1. For multiple compressor assemblies, it is acceptable to isolate each compressor assembly in each circuit in lieu of each compressor.

E. Pressure Relief Device:

1. Comply with requirements in ASHRAE 15, ASHRAE 147, and applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Select and configure pressure relief devices to protect against corrosion and inadvertent release of refrigerant.
3. ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger.

2.7 EVAPORATOR

A. Brazed-plate or shell-and-tube design, as indicated.

B. Brazed Plate:

1. Direct-expansion, single-pass, brazed-plate design.
2. Type 304 or 316 stainless-steel construction.
3. Code Compliance: Tested according to ASME Boiler and Pressure Vessel Code.
4. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping. Furnish flange adapters to mate to flanged piping.
5. Inlet Strainer: Factory-furnished, 40-mesh strainer for field installation in supply piping to evaporator. Manufacturer has option to factory install strainer.

C. Flow Switch: Factory-furnished and -installed, thermal-type flow switch wired to chiller operating controls.

D. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F (minus 29 deg C).

E. Remote-Mounting Kit: Designed for remote field mounting where indicated. Provide kit for field installation.

2.8 AIR-COOLED CONDENSER

A. Coil(s) with integral subcooling on each circuit.

B. Copper Tube with Plate Fin Coils:

1. Construct coils of copper tubes mechanically bonded to aluminum fins.

C. Aluminum Microchannel Coils:

1. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
2. Single- or multiple-pass arrangement.
3. Construct fins, tubes, and header manifolds of aluminum alloy treated with a corrosion-resistant coating.

D. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

E. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.

F. Fan Motors: TENV or TEAO enclosure, with sealed and permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.

1. Overcurrent- and thermal-overload protection not integral to motor is acceptable if provided with chiller electrical power package.

G. Fan Guards: Removable steel safety guards with corrosion-resistant PVC coating.

2.9 INSULATION

A. Closed-cell, flexible, elastomeric thermal insulation complying with ASTM C 534/C 534M, Type I for tubular materials and Type II for sheet materials.

1. Thickness: 1-1/2 inches (38 mm).

B. Adhesive: As recommended by insulation manufacturer.

C. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.

1. Apply adhesive to 100 percent of insulation contact surface.
2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
3. Seal seams and joints to provide a vapor barrier.
4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.
5. Manufacturer has option to factory or field insulate chiller components to reduce potential for damage during installation.
6. Field-Applied Insulation:

a. Components that are not factory insulated shall be field insulated to comply with requirements indicated.
b. Manufacturer shall be responsible for chiller insulation whether factory or field installed to ensure that manufacturer is the single point of responsibility for chillers.
c. Manufacturer's factory-authorized service representative shall instruct and supervise installation of field-applied insulation.
d. After field-applied insulation is complete, paint insulation to match factory-applied finish.

2.10 ELECTRICAL

A. Factory installed and wired, and functionally tested at factory before shipment.

B. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.

C. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.

D. Wiring shall be numbered and color-coded to match wiring diagram.

E. Factory wiring shall be located outside of an enclosure in a metal raceway. Terminal connections shall be made with not more than a 24-inch (610-mm) length of liquidtight conduit.

F. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch. Minimum SCCR according to UL 508 shall be as required by electrical power distribution system, but not less than 65,000 A.

G. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:

1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
2. NEMA KS 1, heavy-duty, nonfusible switch.
3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

H. Each motor shall have overcurrent protection.

I. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.

J. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.

K. Power Factor Correction: Capacitors to correct power factor to [**0.90**] [**0.95**] <**Insert value**> at full load.

L. Controls Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

M. Control Relays: Auxiliary and adjustable time-delay relays, or an integral to water chiller microprocessor.

N. Service Receptacle:

1. Unit-mounted, 120-V GFI duplex receptacle.
2. Power receptacle from chiller internal electrical power wiring.

O. Indicate the following for water chiller electrical power supply:

1. Current, phase to phase, for all three phases.
2. Voltage, phase to phase and phase to neutral for all three phases.
3. Three-phase real power (kilowatts).
4. Three-phase reactive power (kilovolt amperes reactive).
5. Power factor.
6. Running log of total power versus time (kilowatt hours).
7. Fault log, with time and date of each.

2.11 CONTROLS

A. Factory installed and wired, and functionally tested at factory before shipment.

B. Standalone, microprocessor based, with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.

C. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.

D. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, digital display. Display the following:

1. Date and time.
2. Operating or alarm status.
3. Operating hours.
4. Outside-air temperature if required for chilled-water reset.
5. Temperature and pressure of operating set points.
6. Chilled-water entering and leaving temperatures.
7. Refrigerant pressures in evaporator and condenser.
8. Saturation temperature in evaporator and condenser.
9. No cooling load condition.
10. Elapsed time meter (compressor run status).
11. Pump status.
12. Antirecycling timer status.
13. Percent of maximum motor amperage.
14. Current-limit set point.
15. Number of compressor starts.
16. Alarm history with retention of operational data before unit shutdown.
17. Superheat.

E. Control Functions:

1. Manual or automatic startup and shutdown time schedule.
2. Capacity control based on evaporator leaving-fluid temperature.
3. Capacity control compensated by rate of change of evaporator entering-fluid temperature.
4. Chilled-water entering and leaving temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on outside-air temperature.
5. Current limit and demand limit.
6. Condenser-water temperature.

7. External water chiller emergency stop.
8. Antirecycling timer.
9. Automatic lead-lag switching.
10. Ice-building mode.

F. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:

1. Low evaporator pressure or high condenser pressure.
2. Low chilled-water temperature.
3. Refrigerant high pressure.
4. High or low oil pressure.
5. High oil temperature.
6. Loss of chilled-water flow.
7. Loss of condenser-water flow.
8. Control device failure.

G. BAS System Interface: Factory-install hardware and software to enable system to monitor, control, and display chiller status and alarms.

1. Hardwired I/O Points:

a. Monitoring: On/off status, common trouble alarm electrical power demand (kilowatts) electrical power consumption (kilowatt hours).
b. Control: On/off operation, chilled-water discharge temperature set-point adjustment electrical power demand limit.

2. Communication Interface: ASHRAE 135 (BACnet) communication interface shall enable control system operator to remotely control and monitor the water chiller from an operator workstation. Control features and monitoring points displayed locally at water chiller control panel shall be available through DDC system for HVAC.

H. Factory-installed wiring outside of enclosures shall be in NFPA 70-complaint raceway. Make terminal connections with liquidtight or flexible metallic conduit.

2.12 ACCESSORIES

A. Factory-furnished 1” neoprene isolators for field installation.

2.13 CAPACITIES AND CHARACTERISTICS

A. Capacity: See Schedules .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.

1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

A. Coordinate sizes and locations of bases with actual equipment provided. Cast anchor-bolt inserts into concrete bases.

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures with actual equipment provided.

C. Install water chillers on support structure indicated.

D. Equipment Mounting:

1. Install water chillers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Maintain clearances required by governing code.

G. Chiller manufacturer's factory-trained service personnel shall charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

H. Install separate devices furnished by manufacturer and not factory installed.

1. Chillers shipped in multiple major assemblies shall be field assembled by chiller manufacturer's factory-trained service personnel.

3.3 PIPING CONNECTIONS

A. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 232300 "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Where installing piping adjacent to chillers, allow space for service and maintenance.

D. Evaporator Fluid Connections:

1. Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage.
2. Make connections to water chiller with a flange.

3.4 ELECTRICAL POWER CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Provide nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch (13 mm) high. Locate nameplate where easily visible.

3.5 CONTROLS CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between chillers and other equipment to interlock operation as required to provide a complete and functioning system.

C. Connect control wiring between chiller control interface and DDC system for remote monitoring and control of chillers. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."

D. Provide nameplate on face of chiller control panel indicating control equipment designation serving chiller and the I/O point designation for each control connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch (13 mm) high.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
2. Verify that pumps are installed and functional.
3. Verify that thermometers and gages are installed.
4. Operate water chiller for run-in period.
5. Check bearing lubrication and oil levels.
6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
7. Verify proper motor rotation.
8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
9. Verify and record performance of chilled-[**and heat recovery condenser-**]water flow and low-temperature interlocks.
10. Verify and record performance of water chiller protection devices.
11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Visually inspect chiller for damage before starting. Repair or replace damaged components, including insulation. Do not start chiller until damage that is detrimental to operation has been corrected.

E. Prepare a written startup report that records results of tests and inspections.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers. Video record the training sessions and provide electronic copy to Owner.

1. Instructor shall be factory trained and certified.
2. Provide not less than eight hours of training.
3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
5. Obtain Owner sign-off that training is complete.
6. Owner training shall be held at Project site.

END OF SECTION 23 64 23.21

SECTION 23 74 13

PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:

1. Air Mixing Section
2. Filter Section (2” MERV 8 flat section and 2” angled MERV 13 Section)
3. Access Section
4. Hot Water Pre-Heat Coil Section
5. Access Section
6. Chilled Water-Cooling Coil Section
7. Access Section
8. Fan Section (Fan Array with minimum of two fans)
9. Controls section
10. Filter Section (HEPA 99.9% filter modules)
11. Vibration Isolation Roof curbs

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

D. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design RTU supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Wind-Restraint Performance:

1. Basic Wind Speed: 120 MPH
2. Minimum 10 lb/sq. ft (48.8 kg/sq. m) multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.5 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wind-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which RTUs will be attached.
2. Roof openings
3. Roof curbs and flashing.

B. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Seismic Qualification Certification: Submit certification that RTUs, accessories, and components will withstand seismic forces defined in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control test reports.

E. Warranty: Special warranty specified in this Section.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: Two set for each belt-driven fan.
2. Filters: Two set of filters for each unit.

1.9 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:
1. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
2. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for parts, besides controls: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.
2. Warranty Period for Control Boards: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation; a unit of United Technologies Corp.
2. Daikin Applied.
3. Trane.
4. YORK; a Johnson Controls company.

2.2 GENERAL

A. Unit layout and configuration shall be as defined in project plans and schedule.

B. Manufacturer to provide a full perimeter integral base frame for either ceiling suspension of units or to support and raise all sections of the unit for proper trapping. Base frame will either be bolted construction or welded construction. Refer to schedule for base height and construction type. Contractor will be responsible for providing a housekeeping pad when unit base frame is not of sufficient height to properly trap unit. Unit base frames not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel. Unit base height to be included in total height required for proper trap height.

2.3 UNIT CASING

A. Unit manufacturer shall ship unit in segments as specified by the contractor for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel. Casing finished to meet ASTM B117 125-hour salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage.

Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.

B. Casing performance - Casing air leakage shall not exceed leak class 6 (CL = 6) per ASHRAE 111 at specified casing pressure, where maximum casing leakage (cfm/100 ft2 of casing surface area) = CL X P0.65.

C. Air leakage shall be determined at 1.00 times maximum casing static pressure up to 8 inches w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM, as a percentage of supply air, and as an ASHRAE 111 Leakage Class.

D. Under 55F supply air temperature and design conditions on the exterior of the unit of 81F dry bulb and 73F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.

E. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8-inch w.g., whichever is less, and shall not exceed 0.0042 per inch of panel span (L/240).

F. Floor panels shall be double-wall construction and designed to support a 300-lb load during maintenance activities and shall deflect no more than 0.0042 per inch of panel span.

G. Unit casing panels shall be 2-inch double-wall construction, with solid galvanized exterior and solid galvanized interior, to facilitate cleaning of unit interior.

H. Unit casing panels (roof, walls, floor) and doors shall be provided with a minimum thermal resistance (R-value) of 13 Hr*Ft2*ºF/BTU.

I. Unit casing panels (roof, walls, floor) and external structural frame members shall be completely insulated filling the entire panel cavity in all directions so that no voids exist. Panel insulation shall comply with NFPA 90A.

J. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.

K. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.

L. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces.

2.4 OUTDOOR UNIT FEATURES

A. Outdoor Casing Details - In addition to all other details specified within for air handling units, units that are installed outdoors shall also comply with the following –

1. Outdoor air handling units shall have only single door handles for each door linking multiple latching points necessary to maintain the specified air leakage integrity of the unit and ease of maintenance.
2. Unit Paint - External surfaces of all outdoor unit casings shall be prepared and painted with a minimum 1.5 mil thick water based polyurethane finish or equal. Paint shall be able to withstand a salt spray test in accordance with ASTM B117 for a minimum of 500 consecutive hours. Paint shall be Slate Grey unless otherwise indicated in the schedule and drawings.
3. Unit Base - Outdoor units shall have a welded base and steel cross members for structural rigidity and supports the full perimeter of the air handling unit. AHU panels must overhang the primary unit base such that no ledge exists for water to pool . The entire AHU perimeter shall be sealed for additional water management protection. A drain pan under the entire unit or sections shall not be an acceptable alternative to prevent water from entering the building space . Unit base shall be designed to allow the unit to be curb mounted when field-installed as indicated on the schedule and drawings.
4. Unit Roof - Outdoor unit roofs shall incorporate a standing seam on the exterior to ensure a rigid roof construction and prevent water infiltration . Roof assembly shall overhang all walls by 1.5-inch minimum to prevent sheeting from roof to side panels . Rain gutters shall also be provided over all doors to direct rain away from the door assembly. Outdoor roofs shall be sloped, not less than 0.125 inches per foot, for water drainage. Where outdoor units are shipped in multiple sections, provide standing-seam joiners at each split with adhesive, hardware, and cover strips for field joining by the installing contractor.
5. Factory Supplied Roofcurb - Roof curbs shall be provided where indicated on the plans and shall be galvanized steel. Roof curb shall support the full perimeter of the air handling unit, including pipe chases. A 2" x 4" nominal wood nailing strip shall be supplied attached to the roof curb. Wood nailing strip shall be of #4 Spruce or #4 Yellow Pine. Roof curb shall include frame work necessary to support supply and return duct installation prior to unit placement. Roof curb shall be shipped loose for field installation prior to unit placement.

2.5 ACCESS DOORS

A. Access doors shall be 2-inch double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.

B. All doors shall be provided with a thermal break construction of door panel and door frame.

C. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.

D. Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.

E. Handle hardware shall be designed to prevent unintended closure.

F. Access doors shall be hinged and removable without the use of specialized tools.

G. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions.

H. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.

I. All doors shall be a 60-inch high when sufficient unit height is available, or the maximum height allowed by the unit height.

J. A single door handle shall be provided for each door linking multiple latching points necessary to maintain the specified air leakage integrity of the unit.

K. An optional shatterproof window shall be provided in access doors where indicated on the plans. Window shall either be single pane, or thermal dual pane, as defined on schedule. Window shall be capable of withstanding unit operating pressures and shall be safe for viewing UV-C lamps.

2.6 PRIMARY DRAIN PANS

A. All cooling coil sections shall be provided with an insulated, double-wall, galvanized drain pan.

B. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in two planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's requirements.

C. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

D. All drain pan threaded connections shall be visible external to the unit. Threaded connections under the unit floor shall not be accepted.

E. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2-inch beyond the base to ensure adequate room for field piping of condensate traps.

F. The installing contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.

G. Coil support members inside the drain pan shall be of the same material as the drain pan and coil casing.

H. If drain pans are required for heating coils, access sections, or mixing sections they will be indicated in the plans.

2.7 FANS

A. Fan sections shall have a minimum of one hinged and latched access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components.

B. Provide fans of type and class as specified on the schedule. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as an assembly at the operating RPM to meet design specifications. Fans that are selected with inverter balancing shall first be dynamically balanced at design RPM. The fans then will be checked in the factory from

25% to 100% of design RPM to insure they are operating within vibration tolerance specifications, and that there are no resonant frequency issues throughout this operating range. Inverter balancing that requires lockout frequencies inputted into a variable frequency drive to in order to bypass resonant frequencies shall not be acceptable. If supplied in this manner by the unit manufacturer, the contractor will be responsible for rebalancing in the field after unit installation. Fans selected with inverter balancing shall have a maintenance free grounding assembly installed on the fan motor to discharge both static and induced shaft currents to ground.

C. Direct drive plenum fans with integral frame motors, shall be mounted on isolation bases. Fan shall be dynamically balanced throughout the operating range to a BV-3 (0.20 in/s) per AMCA 204 test standard. Fan and motor shall be internally isolated with spring isolators. A flexible connection shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor in order to avoid transmission of noise and vibration through the ductwork and building structure.

D. MOTORS AND DRIVES
   1. Motors shall meet or exceed all NEMA Standards Publication MG 1 - 2006 requirements and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be UL Listed.
   2. Fan Motors shall be heavy duty, open drip-proof operable at scheduled voltage. If applicable, motor efficiency shall meet or exceed NEMA Premium efficiencies.
   3. Direct driven fans utilizing integral frame motors shall use 2-pole (3600 rpm), 4-pole (1800 rpm) or 6-pole (1200 rpm) motors, NEMA Design B, with Class B insulation capable to operate continuously at 104 deg F (40 deg C) without tripping overloads.
   4. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.

2.8 COILS

A. Coils section header end panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.

B. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil.

C. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.

D. Construct coil casings of galvanized steel. End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.

E. All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

F. When two or more cooling coils are stacked in the unit, an intermediate drain pan shall be installed between each coil. The intermediate drain pan shall be designed being of sufficient size to collect all condensation produced from the coil and sloped to promote positive drainage to eliminate stagnant water conditions. The intermediate drain pan shall be constructed of the same material as the sections primary drain pan.

G. The intermediate drain pan shall begin at the leading face of the water-producing device and be of sufficient length extending downstream to prevent condensate from passing through the air stream of the lower coil.

H. Intermediate drain pan shall include downspouts to direct condensate to the primary drain pan. The intermediate drain pan outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

I. Hydronic Coils
   1. Supply and return header connections shall be clearly labeled on unit exterior such that direction of coil water-flow is counter to direction of unit air-flow.
   2. Coils shall be proof-tested to 300 psig and leak-tested to 200 psig air pressure under water.
   3. Headers shall be constructed of round copper pipe or cast iron.
   4. Tubes shall be 5/8-inch .020 copper, with aluminum fins.

2.9 FILTERS

A. Provide factory-fabricated filter section of the same construction and finish as unit casings. Filter section shall have side access filter guides and access door(s) extending the full height of the casing to facilitate filter removal. Construct doors in accordance with Section 2.04. Provide fixed filter blockoffs as required to prevent air bypass around filters. Blockoffs shall not need to be removed during filter replacement. Filters to be of size, and quantity needed to maximize filter face area of each particular unit size.

B. Provide factory-fabricated filter section of the same construction and finish as unit casings. Filter section shall be provided with front loading filter frames. Filter holding frames shall be constructed of galvanized steel and equipped with foam gaskets to seal filters against filter frames. Frame seams shall be sealed to eliminate air bypass. Access door(s) shall be provided to facilitate filter removal. Construct doors in accordance with Section 2.04. Manufacturer to provide necessary filter clips to lock primary and secondary prefilters (if ordered) tightly to filter frame without the need for special tools, bolts or nuts. Filter holding frames shall be of a universal type to accommodate standard filters of 12x24 and 24x24 nominal size as well as appropriate fasteners.

C. The HEPA filter cells shall be enclosed in a galvanized steel frame with neoprene rubber applied to the leaving-air side of the filter cell to reduce air leakage. Front-load filter frames with filter holding clips shall be mounted inside the section casing and shall be gasketed to prevent leakage or air bypass. Filter clips shall require tooling in order to tighten and hold filter cells to frame. Filter media shall be produced from glass waterproof microfiber with a continuous pleat and aluminum separators between pleat folds. Filters as produced shall be capable of operating up to 500-fpm face velocity without loss of filter efficiency. HEPA filter efficiency shall be not less than 99.97 percent when tested in accordance with IEST RP CC 001.4. By definition (IEST RP CC 001.4), HEPA filters are a minimum of 99.97% efficient when tested using 0.3-µm thermally generated particles. Filter frame assemblies when tested in accordance IEST-RP-CC0.34.3 are a minimum of 99.97% efficient when tested using 0.3-µm generated particles. Access door(s) shall be provide to facilitate filter removal. Construct doors in accordance with Section 2.04.

Filters shall be rigid HEPA-type, 12-inch deep, provided as indicated on the schedule and drawings. Filters shall consist of highdensity glass fiber media with corrugated aluminum separators and 100% solid resin. Filters shall be UL Class 1 when tested in accordance with UL Standard 900.

D. Filter type, MERV rating, and arrangement shall be provided as defined in project plans and schedule.

2.10 DAMPERS

A. All dampers, with the exception of external bypass and multizones (if scheduled), shall be internally mounted. Dampers shall be premium ultra low leak and located as indicated on the schedule and plans. Blade arrangement (parallel or opposed) shall be provided as indicated on the schedule and drawings. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and pressure drop. Leakage rate shall not exceed 3 CFM/square foot at one inch water gauge complying with ASHRAE 90.1 maximum damper leakage and shall be AMCA licensed for Class 1A. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. Manufacturer shall submit brand and model of damper(s) being furnished, if not Ruskin CD60.

2.11 ACCESS SECTIONS

A. Access sections shall be provided where indicated in the schedule and plans to allow additional access for inspection, cleaning, and maintenance of unit components. The unit shall be installed for proper access. Procedure for proper access, inspection and cleaning of the unit shall be provided in the AHU manufacturer's maintenance manual.

2.12 DISCHARGE PLENUM SECTIONS

A. Plenums shall be provided as indicated in the schedule and plans to efficiently turn air and provide acoustical attenuation. Discharge plenum opening types and sizes shall be scaled to meet pressure drop requirements scheduled and align with duct takeoffs.

2.13 VFD per Fan

A. Multiple VFDs on a common panel, shall be provided for each fan array to provide redundancy in case of loss of function of one of the VFDs or motors. Individual VFD shall be sized based on motor FLA to reduce overall panel input current. In the event of a VFD failure, the remaining VFDs must be capable of compensating and maintaining normal fan array operation.

B. VFD panel shall have a common disconnect that is accessible from the outside of the unit. Disconnect shall open input power to all VFDs simultaneously. Disconnect shall be lockable in the off position. Disconnect shall utilize circuit breaker to provide overcurrent and short circuit protection.

C. VFD panel shall be provided with a common point connection for speed input signal, start/stop signal, fault status, and field interlock connection.

D. VFD panel shall be provided with a single point of field connection for field input power. Each VFD shall be supplied with independent input fusing, as required. Panel shall be provided with short circuit current of 5kA RMS symmetrical.

E. VFD panel shall be provided with a single point of field connection for field input power. Each VFD shall be supplied with independent input fusing, as required. Panel shall be provided with short circuit current of 65kA RMS symmetrical.

F. Externally mounted VFDs shall be provided with independent keypad.

2.14 Factory Wiring of Lights, VFDs, Motorized Impeller Control Panels, and Combination Starters/Disconnects

A. VFDs shall be wired per NEC, UL, and NFPA 90A requirements. Units with factory-mounted controls shall also include power wiring from the VFD or starter/disconnect control transformer to the control system transformers. Units with VFDs and factory-mounted controls shall have a binary start-stop signal and an analog speed signal wired from the direct digital controller to the VFD.

B. All power wiring for voltages greater than 24V and traveling through multiple unit sections shall be contained in an enclosed, metal, power-wiring raceway or EMT. Sections less than 6-inch in length may be contained in FMC.

C. After mounting and wiring of VFDs, on the AHUs, trained factory personnel shall ensure proper operation of each VFD, through a thorough factory test. Testing shall include a Hypot test of unit wiring to ensure that no weaknesses exist in wiring or motor. Each VFD shall be energized and the fan run to ensure the VFD will operate throughout the usable range of the drive and that the fan rotation is correct. Each VFD with bypass shall also be tested in the bypass position to ensure the bypass is operational.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.Retain paragraph below if unit is installed on field-fabricated curbs or pilings.

B. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.
5. Install normal-weight, 3000-psi (20.7-MPa), compressive strength (28-day) concrete mix inside roof curb, [**4 inches (100 mm)**] <**Insert thickness**> thick. Concrete, formwork, and reinforcement are specified with concrete.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.

    a. Measure gas pressure on manifold.
    b. Inspect operation of power vents.
    c. Measure combustion-air temperature at inlet to combustion chamber.
    d. Measure flue-gas temperature at furnace discharge.
    e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F (8 deg C) above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.

b. Coil entering-air, dry- and wet-bulb temperatures.
c. Outdoor-air, dry-bulb temperature.
d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

27. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. High-temperature limit on gas-fired heat exchanger.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Economizer to minimum outdoor-air changeover.
    e. Relief-air fan operation.
    f. Smoke and firestat alarms.

29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 017900 "Demonstration and Training."

END OF SECTION

SECTION 25 00 00

MECHANICAL SYSTEMS COMMISSIONING

PART 1 GENERAL

1.1 DESCRIPTION

A. The independent commissioning agent shall be hired by the General Contractor such as the following:
   1. Thompson Building Energy Solutions, LLC, Baton Rouge, Louisiana. Contact John Thompson. Office number (225)-490-9583.
   2. Tylor Building Solutions, Inc. Metairie, Louisiana. Contact Ed Taylor. Office number (504)329-8275.
   3. CxA Services, Lafayette, Louisiana. Contact Ken Credeur. Office number (337)237-5396

B. Commissioning requires the participation of Division 23 to ensure that all mechanical systems are operating in a manner consistent with the Contract Documents.

1.2 CxA QUALIFICATIONS

A. The commissioning agent shall have a certification in good standing with AEE, NEBB or AABC.
B. Commissioning agent shall have experience in the commissioning of a minimum of 5 project similar to this project is equipment and size.
C. Commissioning agent shall not be owned by the contractor or the design team associated with the project.

1.3 RESPONSIBILITIES

A. Mechanical, Controls and TAB Contractors. The commissioning responsibilities applicable to each of the mechanical, controls and TAB contractors of Division 23 are as follows (all references apply to commissioned equipment only):

Construction and Acceptance Phases

1. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Cx process.
2. Contractors shall provide the CxA with normal cut sheets and shop drawing submittals of commissioned equipment.
3. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of start-up and functional testing procedures.
   a. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.
   b. The Commissioning Agent may request further documentation necessary for the commissioning process.
   c. This data request may be made prior to normal submittals.
4. Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CxA for review and approval.

5. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
6. Provide limited assistance to the CxA in preparing the specific functional performance test procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
7. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the prefunctional checklists from the CxA for all commissioned equipment. Submit to CxA for review and approval prior to startup.
8. During the startup and initial checkout process, execute the mechanical-related portions of the prefunctional checklists for all commissioned equipment.
9. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.
10. Address current A/E punch list items before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air related systems.
11. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
12. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, CM and A/E and retest the equipment.
13. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
14. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).
15. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
16. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.
2. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

B. Mechanical Contractor. The responsibilities of the HVAC mechanical contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Provide startup for all HVAC equipment, except for the building automation control system.
2. Assist and cooperate with the TAB contractor and CxA by:
   a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
   b. Including cost of sheaves and belts that may be required by TAB.
   c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Providing an approved plug.
   d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.
3. Prepare a preliminary schedule for Division 23 pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CxA. Update the schedule as appropriate.

4. Notify the PM or CxA depending on protocol, when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the PM or CxA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.

C. Controls Contractor. The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
   a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
   b. All interactions and interlocks with other systems.
   c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
   d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
   e. Start-up sequences.
   f. Warm-up mode sequences.
   g. Normal operating mode sequences.
   h. Unoccupied mode sequences.
   i. Shutdown sequences.
   j. Capacity control sequences and equipment staging.
   k. Temperature and pressure control: setbacks, setups, resets, etc.
   l. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
   m. Sequences for all alarms and emergency shut downs.
   n. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
   o. Schedules, if known.
   p. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.

2. Control Drawings Submittal
   a. The control drawings shall have a key to all abbreviations.
   b. The control drawings shall contain graphic schematic depictions of the systems and each component.
   c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
   d. Provide a full points list with at least the following included for each point:
      1) Controlled system
      2) Point abbreviation
      3) Point description
      4) Display unit
      5) Control point or setpoint (Yes / No)
      6) Monitoring point (Yes / No)

7) Intermediate point (Yes / No)
8) Calculated point (Yes / No)

Key:

Point Description: DB temp, airflow, etc.

Control or Setpoint: Point that controls equipment and can have its setpoint changed (OSA, SAT, etc.)

Intermediate Point: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).

Monitoring Point: Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.

Calculated Point: "Virtual" point generated from calculations of other point values.

The Controls Contractor shall keep the CxA informed of all changes to this list during programming and setup.

3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.

4. Assist and cooperate with the TAB contractor in the following manner:

   a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
   b. For a given area, have all required prefunctional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CxA prior to TAB.
   c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

5. Assist and cooperate with the CxA in the following manner:

   a. Using a skilled technician who is familiar with this building, execute the functional testing of the controls system as specified for the controls contractor. Assist in the functional testing of all equipment specified. Provide two-way radios during the testing.
   b. Execute all control system trend logs specified.

D. TAB Contractor. The duties of the TAB contractor, in addition to those listed in (A) are:

1. Six weeks prior to starting TAB, submit to the PM the qualifications of the site technician for the project, including the name of the contractors and facility managers of recent projects the technician on which was lead. The Owner will approve the site technician's qualifications for this project.
2. Submit the outline of the TAB plan and approach for each system and component to the CxA, PM and the controls contractor six weeks prior to starting the TAB. This plan will be developed after the TAB has some familiarity with the control system.
3. The submitted plan will include:
   a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.

b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.
c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
e. Final test report forms to be used.
f. Detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch / submain proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using air flow straighteners or relocating flow stations and sensors will be discussed. Provide the analogous explanations for the water side.
g. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
h. Details of how *total* flow will be determined (Air: sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic, etc.).
i. The identification and types of measurement instruments to be used and their most recent calibration date.
j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.
k. Confirmation that TAB understands the outside air ventilation criteria under all conditions.
l. Details of whether and how minimum outside air cfm will be verified and set, and for what level (total building, zone, etc.).
m. Details of how building static and exhaust fan / relief damper capacity will be checked.
n. Proposed selection points for sound measurements and sound measurement methods.
o. Details of methods for making any specified coil or other system plant capacity measurements.
p. Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.
q. Details regarding specified deferred or seasonal TAB work.
r. Details of any specified false loading of systems to complete TAB work.
s. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.
t. Details of any required interstitial cavity differential pressure measurements and calculations.
u. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
v. Plan for formal progress reports (scope and frequency).
w. Plan for formal deficiency reports (scope, frequency and distribution).

4. A running log of events and issues shall be kept by the TAB field technicians. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the CxA and PM at least twice a week.
5. Communicate in writing to the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.

6. Provide a draft TAB report within two weeks of completion. A copy will be provided to the CxA. The report will contain a full explanation of the methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC, NEBB or ASHRAE Standard 111.
7. Provide the CxA with any requested data, gathered, but not shown on the draft reports.
8. Provide a final TAB report for the CxA with details, as in the draft.
9. Conduct functional performance tests and checks on the original TAB as specified for TAB.

1.3 RELATED WORK

A. Refer to Division 23.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Division 23 shall provide all test equipment necessary to fulfill the testing requirements of this Division. Commissioning agent does not supply any test equipment or perform any testing. All testing will be done by the mechanical contractor.

PART 3 - EXECUTION

3.1 SUBMITTALS

A. Division 23 shall provide submittal documentation relative to commissioning as required in this Section Part 1.

3.2 STARTUP

A. The HVAC mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section. Division 23 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.

B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CxA and PM. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all prefunctional checklists as soon as possible.

3.3 TAB

A. Refer to the TAB responsibilities in Part 1.2 above.

3.4 FUNCTIONAL PERFORMANCE TESTS

A. All HVAC systems shall be commissioned.

3.5 OPERATION AND MAINTENANCE (O&M) MANUALS

A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.

B. Division 23 shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver this documentation to the GC for inclusion in the O&M manuals, according to the specifications, prior to the training of owner personnel.

C. The CxA shall receive a copy of the O&M manuals for review.

D. Special Control System O&M Manual Requirements. In addition to documentation that may be specified elsewhere, the controls contractor shall compile and organize at minimum the following data on the control system in labeled 3-ring binders with indexed tabs.

1. Three copies of the controls training manuals in a separate manual from the O&M manuals.
2. Operation and Maintenance Manuals containing:

    a. Specific instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. These instructions shall be step-by-step. Indexes and clear tables of contents shall be included. The detailed technical manual for programming and customizing control loops and algorithms shall be included.
    b. Full as-built set of control drawings (refer to Submittal section above for details).
    c. Full as-built sequence of operations for each piece of equipment.
    d. Full points list. In addition to the updated points list required in the original submittals (Part 1 of this section), a listing of all rooms shall be provided with the following information for each room:
        1) Floor
        2) Room number
        3) Room name
        4) Air handler unit ID
        5) Reference drawing number
    e. Full print out of all schedules and set points after testing and acceptance of the system.
    f. Full as-built print out of software program.
    g. Electronic copy on disk of the entire program for this facility.
    h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.
    i. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
    j. Control equipment component submittals, parts lists, etc.
    k. Warranty requirements.
    l. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).

3. The manual shall be organized and subdivided with permanently labeled tabs for each of the following data in the given order:
    a. Sequences of operation
    b. Control drawings
    c. Points lists
    d. Controller / module data
    e. Thermostats and timers
    f. Sensors and DP switches
    g. Valves and valve actuators
    h. Dampers and damper actuators
    i. Program setups (software program printouts)

4. Field checkout sheets and trend logs should be provided to the CxA for inclusion in the Commissioning Record Book.

E. Special TAB Documentation Requirements. The TAB will compile and submit the following with other documentation that may be specified elsewhere in the *Specifications.*

1. Final report containing an explanation of the methodology, assumptions, test conditions and the results in a clear format with designations of all uncommon abbreviations and column headings.
2. The TAB shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.

F. Review and Approvals. Review of the commissioning related sections of the O&M manuals shall be made by the A/E and by the CxA. Refer to Section 019113, Part 3.8 for details.

3.6. TRAINING OF OWNER PERSONNEL

A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.

B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

C. Mechanical Contractor. The mechanical contractor shall have the following training responsibilities:

1. Provide the CxA with a training plan two weeks before the planned training.
2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to air conditioning units, air handling units, fans, fan coil units, controls and water treatment systems, etc.
3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
8. Training shall include:

    a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.

b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
c. Discussion of relevant health and safety issues and concerns.
d. Discussion of warranties and guarantees.
e. Common troubleshooting problems and solutions.
f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
g. Discussion of any peculiarities of equipment installation or operation.
h. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.

9. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
10. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not *controlled* by the central control system.
11. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.
12. Duration of training as necessary to properly train owner's staff.

D. Controls Contractor. The controls contractor shall have the following training responsibilities:

1. Provide the CxA with a training plan four weeks before the planned training.
2. The controls contractor shall provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner on all the capabilities of the control system.
3. Training manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals *and* in all software displays. Manuals will be approved by the CxA. Copies of audiovisuals shall be delivered to the Owner.
4. The trainings will be tailored to the needs and skill-level of the trainees.
5. The trainers will be knowledgeable on the system and its use in buildings. For the on-site sessions, the most qualified trainer(s) will be used. The Owner shall approve the instructor prior to scheduling the training.
6. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
7. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

E. TAB The TAB contractor shall have the following training responsibilities:

1. TAB shall meet for ___2____ hours with facility staff after completion of TAB and instruct them on the following:
   a) Go over the final TAB report, explaining the layout and meanings of each data type.
   b) Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.

c) Identify and discuss any duct runs, diffusers, coils and fans that are close to or are not meeting their design capacity.
d) Discuss any temporary settings and steps to finalize them for any areas that are not finished.
e) Other salient information that may be useful for facility operations, relative to TAB.

3.8. DEFERRED TESTING

A. Shall be scheduled on an as needed basis.

3.9 WRITTEN WORK PRODUCTS

A. Written work products of Contractors will consist of the start-up and initial checkout plan and the filled out start-up, initial checkout and prefunctional checklists.
B. Written work products for Commissioning Agent shall be commissioning summary report including completed checklist, issues log and summary of commissioning activities.

END OF SECTION 25 00 00

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Supporting devices for electrical components.
2. Electricity-metering components.
3. Concrete equipment bases.
4. Touchup painting.

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. RNC: Rigid nonmetallic conduit.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.4 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate electrical service connections with buildings and grounds.

D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

E. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

F. Coordinate connecting to all equipment with equipment provider. This includes mechanical, plumbing, owner provided and contractor provided equipment. Contractor to refer to equipment installation documents prior to any rough-in.

G. Contractor to coordinate with door hardware provider, architect and owner prior to installation of any devices associated with doors to verify door operational requirement, placement of proximity readers, motion sensors, door switches, fire alarm control, magnetic locks, hold open devices, etc..

H. Contractor to coordinate with architectural millwork shop drawings prior to rough-in for locations of under counter lighting to be installed in and around millwork. No receptacles shall be installed in an enclosed cabinet unless noted on the drawings. Outlets for refrigerators, microwaves, etc. shall be installed in the space identified on the millwork shop drawings.

I. Contractor shall not penetrate any stair wall assemble with conduit, boxes, cabling and the like, except for items that serve the stairwell.

J. The contractor shall label the main service disconnecting means with the maximum available fault current shall be listed on the device to meet the requirements of NFPA 70:110.24. The labeling shall be engraved plastic. The maximum available fault current shall be obtained from the electrical utility for the secondary side of the utility transformer.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

E. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

F. Expansion Anchors: Carbon-steel wedge or sleeve type.

G. Toggle Bolts: All-steel springhead type.

H. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 EQUIPMENT FOR ELECTRICITY METERING BY CONTRACTOR

A. Meter: Contractor shall provide metering per the local utility. Contractor shall provide all necessary enclosures, meter cans, etc. per the local utility requirements including any fees associated with the service.

2.3 CONCRETE BASES

A. Concrete: 3000-psi (20.7-MPa), 28-day compressive strength as specified

2.4 TOUCH-UP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb (90-kg) design load.

3.3 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Install 1/4-inch- (6-mm-) diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Simultaneously install vertical conductor supports with conductors.

J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.

K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts.
5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
6. Steel: Welded threaded studs or spring-tension clamps on steel.
   a. Field Welding: Comply with AWS D1.1.

7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
8. Light Steel: Sheet-metal screws.
9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 FIRESTOPPING AND FIRE RATED WALLS/CEILINGS/FLOORS

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.5 CONCRETE BASES

A. Provide a concrete base for all floor mounted equipment. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete."

3.6 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.7 REFINISHING AND TOUCH-UP PAINTING

A. Refinish and touch up paint.

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.8 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70- Latest edition or edition enforced by state and local code authority.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

B. Conductor Material: Copper; stranded conductor or solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

C. Conductor Insulation Types: Type THHN-THWN.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Exposed Branch Circuits, including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway or MC Cable.

G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

H. Fire Alarm Cabling: Plenum rated in plenum areas, exposed above accessible ceilings and in conduit when concealed in finished walls, unaccessible ceilings. Secured per NFPA 70-760.

I. Low Voltage Cabling: Plenum rated in plenum areas, exposed above accessible ceilings and in conduit when concealed in finished walls, unaccessible ceilings. Secured per NFPA 70-760.

J. Single Phase Circuits: Provide a dedicated neutral. Sharing of neutrals is not allowed.

3.2 INSTALLATION

A. Conceal cables in conduit in finished walls, unaccessible ceilings, and floors.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Support cables according to Section "Basic Electrical Materials and Methods."

E. Identify and color-code conductors and cables according to Section "Electrical Identification."

F. Use #10 AWG conductors for 20 amperage 120 circuits when the circuit conductors are longer than 75 feet. Use #10 AWG conductors for 20 amperage 277 circuits when the circuit conductors are longer than 200 feet.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

1. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.
   1. Underground grounding.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

   1. Solid Conductors: ASTM B 3.
   2. Stranded Conductors: ASTM B 8.
   3. Tinned Conductors: ASTM B 33.
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
   1. No. 4 AWG minimum, soft-drawn copper.
   2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.

D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches by 24” minimum in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by10 feet (19 mm by 3 m) in diameter.

2.4 GROUND ACCESS WELLS

A. Molded high density polyethylene well with 9” diameter twist-lock cover and locking bolt. Two knock-outs (mouse holes) for routing conductor to inside. Harger #GAW910 or equal.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits

D. Pad-Mounted Transformers and Switches: The following is a minimum if the utility company does not have requirements, otherwise meet the utility company requirements. Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
10. X-ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

G. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

3. Install ground access well with cover for each ground rod (mounted flush with finished grade).

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

G. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of building as indicated on detail or drawings.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building foundation.

H. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Manhole Grounds: 10 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
   g. Wesanco, Inc.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Hilti Inc.
2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
3) MKT Fastening, LLC.
4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Cooper B-Line, Inc.; a division of Cooper Industries.
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti Inc.
4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps / single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC RMC EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Refer to architectural for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
2. "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
3. "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. LFNC: Liquidtight flexible nonmetallic conduit.

G. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, floor boxes, and cabinets.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70-Latest edition or edition enforced by state and local code authority.

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 METAL WIREWAYS

A. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1 or 3R.

B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

D. Wireway Covers: Hinged type.

E. Finish: Manufacturer's standard enamel finish.

2.2 NONMETALLIC WIREWAYS

A. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.

B. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

2.3 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating and two coats of paint. Color by Architect.

B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Floor Boxes: Cast metal, fully adjustable, rectangular with four separate wiring compartments for power outlets, voice and data outlets, and/or AV devices as indicated on the drawing. Wiremold RFB4 Series, T&B 665 Series or approved equal. Covers shall be UL Listed to U.S. and Canadian safety standards for tile, carpet, wood, bare concrete and terrazzo floors. Covers shall be selected by the architect and shall be of Nickel, Brass, Black, Gray or Bronze.

B. Poke Thru Floor Boxes: Two hour rated poke thru floor unit with capabilities of two duplex power receptacles, data and AV devices. Provide power, data and phone outlets indicated on drawing. Wiremold Evolution Series 6AT or prior approved equal. Covers shall be selected by the architect and shall be of Nickel, Brass, Black, Gray or Bronze. Poke thru floor boxes are to be utilized on upper floors unless noted otherwise. There must be accessibility in the space below the poke thru box.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

D. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

F. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

G. Exterior Outlet Lock Box: Cast aluminum with self closing door withlock. All units shlal be keyed alike. 16 gauge steel housing. Unit for Interior and Exterior installation. Cole: TL-310 or equivalent.

H. In grade enclosures, boxes and covers are required to conform to all test provisions of the most current ANSI/SCTE 77 “Specification For Underground Enclosure Integrity” for Tier 22 applications. When multiple “Tiers” are specified the boxes must physically accommodate and structurally support compatible covers while possessing the highest Tier rating. All covers are required to have the Tier level rating embossed on the surface. In no assembly can the cover design load exceed the design load of the box. All components in an assembly (box & cover) are manufactured using matched surface tooling. Independent third party verification or test reports stamped by a registered Professional Engineer certifying that all test provisions of this specification have been met are required with each submittal. Cover to labeled per use of box, ie “Electrical, Communications, etc”. Communications pull boxes shall be a minimum of 24" w x 36" l x 36 “ d.

2.5 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

2.6 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.

B. Aluminum Rigid Conduit: ANSI C80.5.

C. IMC: ANSI C80.6.

D. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

E. Plastic Coated IMC and Fittings: NEMA RN 1.

F. EMT and Fittings: ANSI C 80.3.

G. EMT and Fittings: ANSI C80.3.

H. FMC: Aluminum

I. LFMC: Flexible steel conduit with PVC jacket.

J. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid steel or IMC.
2. Concealed: Rigid steel or IMC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 4.

B. Indoors:

1. Exposed: EMT in non finished areas. Surface metal raceway in existing finished unaccessible areas unless noted otherwise.
2. Concealed: EMT. MC cable allowed for concealed non-essential branch lighting and receptacle branch circuits. Hospital grade MC for non-essential branch patient care spaces.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations above Ground: Rigid steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
   a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

C. Minimum Raceway Size: 3/4-inch trade size (DN 21) below grade and ½ inch trade size above grade.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

E. Contractor to provide metal raceway in Patient Care Areas per 517.13. Raceway shall be installed as a redundant ground. Raceway shall be a considered a ground.

3.2 INSTALLATION

A. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in "Basic Electrical Materials and Methods."

D. Install temporary closures to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover. Conduits larger than 1” shall not be installed in the slab.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

J. Join raceways with fittings designed and approved for that purpose and make joints tight.

1. Use insulating bushings to protect conductors.

K. Tighten set screws of threadless fittings with suitable tools.

L. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.

2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

N. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

O. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

P. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

Q. Set floor boxes level and flush with finished floor surface.

R. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Identification for conductors and communication and control cable.
2. Warning labels and signs.
3. Instruction signs.
4. Equipment identification labels.
5. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes and standards. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.3 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.4 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb, minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.

1. Exterior Concrete Unit Masonry:
   a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
      1) Block Filler: Concrete unit masonry block filler.
      2) Finish Coats: Exterior semigloss acrylic enamel.

2. Exterior Ferrous Metal:
   a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
      1) Primer: Exterior ferrous-metal primer.
      2) Finish Coats: Exterior semigloss alkyd enamel.

3. Exterior Zinc-Coated Metal (except Raceways):
      1) Primer: Exterior zinc-coated metal primer.
      2) Finish Coats: Exterior semigloss alkyd enamel.

4. Interior Ferrous Metal:
   a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      1) Primer: Interior ferrous-metal primer.
      2) Finish Coats: Interior semigloss acrylic enamel.

5. Interior Zinc-Coated Metal (except Raceways):
   a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      1) Primer: Interior zinc-coated metal primer.
      2) Finish Coats: Interior semigloss acrylic enamel.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.

B. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

C. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.

2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

E. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:
   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Electrical switchgear and switchboards.
   d. Transformers.
   e. Emergency system boxes and enclosures.
   f. Receptacles with panel and circuit numbers.
   g. Disconnect switches.
   h. Enclosed circuit breakers.
   i. Power transfer equipment.
   j. Contactors.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service feeder branch-circuit service, feeder, and branch-circuit conductors.

1. Color shall be factory applied factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
3. Colors for 480/277-V Circuits:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

END OF SECTION 26 05 53

SECTION 26 05 73 - OVERCURRENT PROTECTION DEVICE COORDINATION STUDY

PART 1 – GENERAL

1.1 SCOPE

A. The contractor shall provide an engineering analysis and coordination study for the entire electrical distribution system. The analysis shall include a short-circuit analysis with protective device evaluation, emergency power system selective coordination study, a protective device coordination study and an arc fault hazard analysis study.

B. The project shall begin at the point of utility service on the primary side for the facility and continue down through the system, to all downstream distribution and branch panelboards, motor control centers and significant motor locations.

1.2 RELATED DOCUMENTS

A. Single line diagrams

B. Specifications

1.3 SUBMITTALS

A. General. Submit the following according to Conditions of the Contract and Division 1 Specification Sections:

B. Submit for review six copies of the protection coordination study.

C. Shop drawings for equipment effected by the coordination study will not be reviewed until the coordination study has been submitted and approved.

D. Qualification data for firms and persons specified in the “Quality Assurance” Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Engineer and Owner, and other information specified.

E. A one-line diagram of the system shall be included.

F. The final report shall be bound in a three-ring binder.

G. The final report shall contain individual, tabbed sections for each section. Each tabbed section shall contain the information as outlined in Part 2 of this document. Tab 1 shall list the manufacturer’s name, address, general business phone number, after hours service phone number, spare parts phone number, distributor’s name, address, general business phone number, after hours service phone number and spare parts phone number. Tab 2 shall contain Section 2.2’s short-circuit analysis with protective device evaluation. Tab 3 shall contain Section 2.3’s protective device coordination study. Tab 4 contains Section 2.4’s information and so on.

H. Arc flash labels shall be provided in hard copy and in electronic format.

1.4 Emergency Power System Selective Coordination Study

A. Four copies of the Emergency Power System Selective Coordination Study including, but not limited to:

1. Time-current characteristic curve drawings on log-log printouts which illustrate:

a. Compliance of the provided overcurrent protective devices with the specified selective coordination requirements.

b. The recommended settings for all adjustable relays, overcurrent protective devices and ground fault protective devices provided for the project.

c. A tabulation of the recommended settings for all adjustable relays, overcurrent protective devices and ground fault protective devices and type selections for fuse protective devices supplied.

d. An analysis of the results in which any inadequacies related to the specified selective coordination shall be called to the attention of the Engineer with recommendations for improved coordination.

1.5 RELATED STANDARDS

A. All studies shall be performed in accordance with the latest applicable IEEE and ANSI standards.

1.6 QUALITY ASSURANCE

A. Preparer Qualifications: The study shall be prepared in accordance with the latest edition of NETA Std. ATS, NFPA 70B, the “National Electrical Code”, ANSI C2” National Electrical Safety Code”, and ANSI/IEEE Guidelines, as well as manufacturer’s recommendations.

B. Short-Circuit Analysis and Coordination Study shall be performed by a registered Professional Engineer. Study shall be signed and sealed by the Engineer. The Engineer shall have a minimum of eight years experience in the analysis, evaluation, and coordination of electrical distribution systems. The study must be prepared by a Louisiana licensed professional electrical engineer.

C. The firm conducting the study shall have one million worth of Professional Liability Insurance in addition to standard general insurance.

1.7 DELIVERY, STORAGE AND HANDLING

A. The six sets of submittals shall be submitted for review and approval.

B. The six sets are due no later than 4 weeks after contract award and are required prior to the review of the shop drawings.

PART 2 - PRODUCTS

2.1 SHORT-CIRCUIT ANALYSIS WITH PROTECTIVE DEVICE EVALUATION

A. Systematically calculate fault currents based on the available fault current at the facility service entrance. Study preparer shall obtain the available fault current from the local utility.

B. Short-circuit calculations shall be prepared by means of a digital computer utilizing a commercially available software package. Motor contribution shall be incorporated in determining fault levels. Results of short-circuit calculations shall be presented in tabular form and shall include momentary and interrupting fault values for three-phase and phase-to-ground faults.

C. Analyze the short-circuit currents by preparing a tabulation comparing the fault levels to the device interrupting ratings. Indicate areas in which integrated/series ratings are utilized. The following information shall be included in the tabulation:
   1. Bus identification number.
   2. Location identification.
   3. Voltage
   4. Manufacturer and type of equipment.
   5. Device rating.
   6. Calculated short-circuit current.

D. Protective Device Evaluation:

   1. Evaluate equipment and protective devices and compare to short-circuit ratings.
   2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
   3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
   4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
   5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

2.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Prepare coordination time-current characteristic curves to determine the required settings/sizes of the protective devices to maximize selectivity. The utility upstream protective device feeding the facility shall be maintained as the upper limit for coordination. These settings shall be obtained by the preparer, along with any other protective device setting requirements. The coordination curves shall be prepared on log-log paper and illustrate adequate clearing times between series devices. The curves shall be created through the use of the study software package, but must reflect actual protective devices to be installed. Adequate time-current curves shall be generated to depict coordination. In addition, protective device characteristics shall be suitably determined to reflect calculated short-circuit levels at the location.

B. A narrative analysis shall accompany each coordination curve sheet and describe the coordination and protection in explicit detail. All curve sheets shall be multi-color for improved clarity. Areas lacking complete coordination shall be highlighted and reasons provided for allowing condition to remain or provide solution to resolve situation. System coordination, recommended ratings, and setting of protective devices shall be accomplished by a registered professional electrical engineer with a minimum of eight years of current experience in the coordination of electrical power systems.

C. The following information shall be provided on all curve sheets.
   1. Device identification and associated settings/size.
   2. Voltage at which curves are plotted.
   3. Current multiplier.
   4. ANSI frequent fault damage curve.
   5. Cable insulation damage curves.
   6. Transformer inrush point.
   7. Single-line for the portion of the system.
   8. Motor starting profiles (where applicable).

2.3 ARC FAULT STUDY AND COORDINATION

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.4 SINGLE-LINE DIAGRAM

A. The final report shall include a multi-color single-line diagram of the electrical distribution system within the scope of the project. The single-line shall include:
   1. Transformer rating, voltage ratio, impedance, and winding connection.
   2. Feeder cable phase, neutral and ground sizes, length of cable, conductor material, and conduit size and type.
   3. Switchgear, switchboards, panelboards, MCC's, fuses, circuit breakers, ATS's and switches continuous current ratings.
   4. Protective relays with appropriate device numbers and CT's and PT's with associated ratios.
   5. Detailed legend indicating device type identification and other significant details.

2.5 EMERGENCY POWER SYSTEM SELECTIVE COORDINATION STUDY

A. The Emergency Power System Selective Coordination Study shall comply with all applicable NEC requirements and shall start at the electric service and emergency power source(s) and include all electrical distribution equipment protective devices to and including the final branch circuit protective devices serving applicable emergency loads. The curves and settings for the Power Company protective devises shall be included in the scope of this study. The coordination plots shall terminate with the final branch circuit protective devices serving applicable emergency loads. The protective device study shall include a separate analysis for phase and ground protection.

B. The Study shall include the following:
   1. Confirmation of selective coordination of all overcurrent devices associated with supplying utility and generator/UPS to emergency loads in accordance with all applicable requirements of NEC Article 100 and Paragraphs 700.27 and 701.18. Study shall be based on coordination to [0.1] [0.01] seconds. Study shall be based on the actual electrical equipment and overcurrent protective devices being submitted for the project.
   2. Time-current coordination plots shall be made on log-log sheets or equivalent software generated plots and shall graphically indicate the coordination proposed for all of the key systems. The plots shall include complete titles, one-line diagram and legend.
   3. Circuit breakers shall indicate manufacturer and type and have instantaneous, short delay, long-time pick-up and ground fault trip settings and ground fault ampere and time delay settings identified as plotted. Sensor or monitor rating shall be stated for each circuit breaker. All regions of the circuit breaker curve shall be identified. Circuit breaker curves shall include complete operating bands, terminating with the appropriate available short circuit current.
   4. Fuses shall have fuse manufacturer and type indicated. Fuse curves shall be identified as either total clearing time or damage time as applicable.
   5. High voltage relays shall indicate manufacturer and type and have coil taps, time-dial settings and pick-up settings identified as plotted. Current transformer ratios shall be stated. Relays shall be separated by a 0.45 second time margin to assure proper selectivity where feasible. The relay operating curves shall be suitably terminated to reflect the actual maximum fault current sensed by the device.
   6. A summary tabulation shall be provided listing manufacturer and type for all overcurrent protective devices and all recommended settings of each adjustable band included in each device.
   7. Confirmation that the proposed overcurrent protection devices, set or selected as recommended, will provide the specified selective coordination. Should the overcurrent devices proposed for the project not be capable of providing the specified selective coordination, the report shall include recommendations for overcurrent protective device changes required to provide the specified coordination and calculations, plots, recommended settings as specified herein for the recommended overcurrent device changes to provide the specified selective coordination.
   8. All information shall be presented in a report form, signed and sealed by the Engineer

providing the analysis.

2.6 COMPUTER SOFTWARE

A. Comply with IEEE 242, IEEE 1584, NFPA 70E, IEEE 399 and IEEE 551.

B. Retain first paragraph below if the software used for this study should have the capability of protective device coordination and arc-flash studies. See Evaluations for more information.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

PART 3 - EXECUTION

3.1 SUMMARY

A. The results of the system studies shall be summarized in a final report.

B. Where required, copies of the final report shall be submitted to the power company for their review and approval. Approved copies or the report shall be submitted to the Design Engineer.

3.2 SHORT-CIRCUIT STUDY

A Perform study following the general study procedures contained in IEEE 399.

E. Calculate short-circuit currents according to IEEE 551.

F. Base study on the device characteristics supplied by device manufacturer.

G. The extent of the electrical power system to be studied is indicated on Drawings.

H. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

I. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

J. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

K. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Incoming switchgear.
3. Low-voltage switchgear.
4. Motor-control centers.
5. Control panels.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.
8. Disconnect switches.

3.3 FIELD SETTINGS

A. The contractor shall engage the gear manufacture's service group to perform field adjustments of the protective devices as required for placing the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study and protective device evaluation / coordination study.

B. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination study, shall be carried out by manufacturer’s service group.

3.4 ARC FLASH WARNING LABELS

A. The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. The label shall include the following information, at a minimum:

1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category
5. Incident energy
6. Working distance
7. Engineering report number, revision number and issue date.

D. Labels shall be machine printed, with no field markings.

E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 600, 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
2. For each motor control center, one arc flash label shall be provided.

3. For each low voltage switchboard, one arc flash label shall be provided.

4. For each switchgear, one flash label shall be provided.

5. For medium voltage switches one arc flash label shall be provided.

F. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.5 ARC FLASH TRAINING

A. The contractor of the Arc Flash Hazard Analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent.

END OF SECTION 26 05 73

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Outdoor photoelectric switches.
3. Indoor occupancy sensors.
4. Lighting contactors.
5. Emergency shunt relays.

B. Related Sections include the following:
1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.

2. Layout of all devices on floor plan. Work to be done in electronic form such as AutoCAD. Manufacture shall provide a design to accommodate proper coverage throughout.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Color of all wall mounted devices of this section shall match color of devices and plates of the wiring device section.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Grasslin Controls Corporation; a GE Industrial Systems Company.
2. Intermatic, Inc.
3. Leviton Mfg. Company Inc.
4. Lightolier Controls; a Genlyte Company.
5. Lithonia Lighting; Acuity Lighting Group, Inc.
6. Paragon Electric Co.; Invensys Climate Controls.
7. Square D; Schneider Electric.
8. TORK.
9. Touch-Plate, Inc.
10. Watt Stopper (The).

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: DPDT.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
4. Programs: 2 channels; each channel shall be individually programmable with 8 on-off set points on a 24-hour schedule.
5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
6. Astronomic Time: All channels.
7. Battery Backup: For schedules and time clock.

C. Electromechanical-Dial Time Switches: Type complying with UL 917.

1. Contact Configuration: DPDT.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.

4. Astronomic time dial.
5. Eight-Day Program: Uniquely programmable for each weekday and holidays.
6. Skip-a-day mode.
7. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Grasslin Controls Corporation; a GE Industrial Systems Company.
3. Intermatic, Inc.
4. Lithonia Lighting; Acuity Lighting Group, Inc.
5. GreenGate.
6. Paragon Electric Co.; Invensys Climate Controls.
7. Square D; Schneider Electric.
8. TORK.
9. Touch-Plate, Inc.
10. Watt Stopper (The).

B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

C. Description: Solid state, with DPST dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; complying with UL 773.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
2. Time Delay: 30-second minimum, to prevent false operation.
3. Lightning Arrester: Air-gap type.
4. Mounting: Twist lock complying with IEEE C136.10, with base.

2.3 INDOOR OCCUPANCY SENSORS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Lighting.
2. Leviton Mfg. Company Inc.
3. Lithonia Lighting; Acuity Lighting Group, Inc.

4. GreenGate.
5. Sensor Switch, Inc.
6. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.
8. Wall mounted devices color shall match color selected for switches and receptacles. Refer to other sections in specifications.
9. Meet Nema WD 7-2011 requirements.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.

D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

F. System and Design Requirements:
1. Products supplied shall be from a single manufacturer that has been continuously involved in manufacturing of occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.
2. All components shall be U.L. listed, offer a five (5) year warranty and meet all state and local applicable code requirements.
3. Products shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
4. The objective of this section is to ensure the proper installation of the occupancy sensor based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.
5. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits
6. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.
7. Meet Nema WD 7-2011 requirements.

2.4 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Eaton Electrical Inc.; Cutler-Hammer Products.
4. GE Industrial Systems; Total Lighting Control.
5. Grasslin Controls Corporation; a GE Industrial Systems Company.
6. Hubbell Lighting.
7. Lithonia Lighting; Acuity Lighting Group, Inc.
8. MicroLite Lighting Control Systems.
9. Square D; Schneider Electric.
10. TORK.
11. Touch-Plate, Inc.
12. Watt Stopper (The).

13. Siemens

B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The drawings indicate only the rooms which are to be provided with sensors. The contractor shall provide sensors as required to properly and completely cover the respective room.

B. It is the contractor’s responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at owner's facility, to verify placement of sensors and installation criteria.

C. It is the contractor’s responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at owner's facility, to verify placement of sensors and installation criteria.

D. Contractor's work to include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described

herein. Drawings may indicate the room in which occupancy sensor control is required. The contractor and manufacture shall provide a device to provide proper coverage of the area.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

C. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control system.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 09 23

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.2 SUBMITTALS

A. Product Data Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Wiring and connection diagrams.

C. Output Settings Reports: Record of tap adjustments specified in Part 3.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with IEEE C 57.12.91.

C. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting DOE 2016, Class 1 efficiency levels when tested according to DOE 2016.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.5 COORDINATION

A. Coordinate installation of wall-mounting and structure-hanging supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cutler-Hammer
2. GE Electrical Distribution & Control
3. Olsun
4. Siemens Energy & Automation, Inc
5. Square D/Groupe Schneider NA

2.2 MATERIALS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices, except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, DOE 2016 and list and label as complying with UL 1561.

B. Provide transformers that are internally braced to withstand seismic forces specified in "Seismic Controls for Electrical Work."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.

E. Indoor Transformer Enclosure Finish: Comply with NEMA 250 for "Indoor Corrosion Protection."

1. Finish Color: Gray.

F. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

G. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.

H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

J. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

K. Wall Brackets: Manufacturer's standard brackets.

L. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

M. Transformers shall be energy efficient per DOE 2016 standards.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls and floors for suitable mounting conditions where transformers will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

3.3 CONNECTIONS

A. Ground equipment according to NFPA-70.

B. Connect wiring according to "Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. .

3.4 ADJUSTING

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

END OF SECTION 26 22 00

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes service and distribution switchboards rated 600 V and less.

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.3 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of switchboards and overcurrent protective devices.
d. Descriptive documentation of optional barriers specified for electrical insulation and isolation.
e. Metering provisions.
f. UL listing for series rating of installed devices.
g. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For switchboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," include the following:

1. Routine maintenance requirements for switchboards and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70-2011.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards, including clearances between switchboards, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver in sections of lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchboards; install electric heating (250-W per section) to prevent condensation.

D. Handle switchboards according to manufactures requirements.

1.6 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. If the switchboard is utilized as a Main Service Disconnect then the maximum available fault current shall be listed on the device to meet the requirements of NFPA 70:110.24. The labeling shall be engraved plastic. The maximum available fault current shall be obtained from the electrical utility for the secondary side of the utility transformer.

1.7 EXTRA MATERIALS

A. Spares: For the following:

1. Potential transformer fuses.
2. Control-power fuses.

B. Spare Indicating Lights: Six of each type installed.

PART 2 - PRODUCT

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Corp.; Cutler-Hammer Products, Pow-R-Line C.
2. General Electric Co.; Electrical Distribution & Control Div., Spectra/AV.
3. Siemens Energy & Automation, Inc., SB 3/SB2
4. Square D Co.,QED-2, QED-S.

2.2 MANUFACTURED UNITS

A. Front-Connected, Front-Accessible Switchboard: Panel-mounted main device, panel-mounted branches, and sections rear aligned.

B. Nominal System Voltage: 480Y/277 V.

C. Main-Bus Continuous: Average indicated on schedule.

2.3 FABRICATION AND FEATURES

A. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

B. Barriers: Between adjacent switchboard sections.

C. Insulation and isolation for main and vertical buses of feeder sections.

D. Buses and Connections: Three phase, four wire, unless otherwise indicated. Include the following features:

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.
2. Load Terminals: Insulated, rigidly braced, silver-plated, copper runback bus extensions equipped with pressure connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full ampere rating of circuit-breaker position.
3. Ground Bus: 1/4-by-2-inch (6-by-50-mm) minimum size, drawn-temper copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
4. Contact Surfaces of Buses: Silver plated.
5. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.

6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

7. Neutral Buses: 100 percent of the ampacity of the phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus is braced.

E. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable electronic trip setting for circuit-breaker frame sizes 125 A and larger. 100% rated.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Arc Energy Reduction: Arc energy reducing maintenance switching device with local status indicator for circuit breakers rated or adjustable to 1200A or higher to meet the requirements of NEC 240.87.

2.5 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.

2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.

4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondaries to ground overcurrent relays to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

a. Phase Currents, Each Phase: Plus or minus 1 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
d. Megawatts: Plus or minus 2 percent.
e. Megavars: Plus or minus 2 percent.
f. Power Factor: Plus or minus 2 percent.
g. Frequency: Plus or minus 0.5 percent.

h. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.Accumulated Energy, Megawatt Hours: Plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.

2. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.

PART 3 - EXECUTION

3.1 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.2 EXAMINATION

A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Install switchboards and accessories according to manufactures requirements.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

C. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."

B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.5 CONNECTIONS

A. Install equipment grounding connections for switchboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.6 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

3.7 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.8 CLEANING

A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 24 13

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.

6. Include evidence of NRTL listing for series rating of installed devices.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
3. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407.

1.10 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Architect's written permission.
3. Comply with NFPA 70E.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    b. Outdoor Locations: NEMA 250, Type 3R.
    c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
    d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.

2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Finishes:

    a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Galvanized steel.

G. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

    a. Plating shall run entire length of bus.
    b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Split Bus: Vertical buses divided into individual vertical sections.

I. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.

3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent.

L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: As per schedule

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on electronic circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: As indicated on the schedules.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

F. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

1. Doors: Concealed hinges secured with multipoint latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; by Schneider Electric.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

a. RMS sensing.

b. Field-replaceable rating plug or electronic trip.
c. Digital display of settings, trip targets, and indicated metering displays.
d. Multi-button keypad to access programmable functions and monitored data.
e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
f. Integral test jack for connection to portable test set or laptop computer.
g. Field-Adjustable Settings:

1) Instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time adjustments.
4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.
d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
g. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 26 09 13 "Electrical Power Monitoring and Control."
h. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
i. Auxiliary Contacts: Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
j. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
k. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
l. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 26 28 13 "Fuses."
2. Fused Switch Features and Accessories:

a. Standard ampere ratings and number of poles.

b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.

2.5 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover. Typed written.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NECA 407.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NECA 407.

D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
3. Comply with requirements for seismic control devices specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

J. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

K. Install filler plates in unused spaces.

L. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

M. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

N. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73.16 "Coordination Studies."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 2500 - ISOLATED POWER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

This Section includes HOSPITAL ISOLATED power distribution panels, including the following type(s):

1. Isolation Distribution Panels
2. Isolation Distribution Centers
3. Duplex Isolation Distribution Panels
4. Laser Isolation Distribution Panels
5. Dual Voltage Isolation Distribution Panels

1.2 SCOPE

The contractor shall furnish, install, and ensure proper testing and certification of a complete isolated power system, including associated accessories, as indicated on the electrical plans, wiring diagrams, panel schedules, and as specified herein.

1.3 SUBMITTALS

Product Data: Provide dimensions, ratings, operating characteristics, and included accessories.

Installation/Operation Instructions: Provide instructions for handling, installation, and operation of product.

1.4 REFERENCES

NFPA 70 – National Electric Code, Article 517

NFPA 99 – Health Care Facilities

UL 1022 – Line Isolation Monitors

UL 1047 – Isolated Power System Equipment

UL 50 – Enclosures for Electrical Equipment

1.5 APPROVED MANUFACTURERS

This specification is based on equipment manufactured by PG LifeLink (formerly Post Glover Medical).

Products of other manufacturers will be considered provided they are equal in all respects.

Approved alternative manufacturers:

1. Square D
2. Bender

PART 2 - PRODUCTS

2.1 ISOLATION DISTRIBUTION PANELS

Provide Isolation Distribution Panels for all operating rooms and other critical procedure areas as indicated on contract drawings. Isolation Distribution Panels are intended to serve medical equipment in a single patient area.

Isolation Distribution Panels shall be a three-piece assembly consisting of: back box, component chassis, and front trim. For ease of installation, component chassis shall be pre-assembled, pre-wired, and shall contain isolation transformer, Line Isolation Monitor (LIM), primary main and total quantity of factory installed secondary branch circuit breakers as indicated on panel schedule(s).

Panels shall be single-phase with voltage and load ratings as indicated on panel schedule(s).

Enclosure depth shall be a maximum of 8 inches for units up to 10kVA.

Panels shall be flush mount. Back boxes shall be available for shipment during rough-in construction stage. Pre-wired component chassis and front trim shipped according to construction schedule.

Where contract drawings call for panels to be installed outside of the room being served, a Remote Annunciator connected to the Line Isolation Monitor shall be installed inside the room.

PG LifeLink model IPP panels shall be basis for design.

2.2 ISOLATION DISTRIBUTION CENTERS

Provide Isolation Distribution Centers for all ICU, Trauma, and other critical procedure areas as indicated on contract drawings. Isolation Distribution Panels are intended to serve medical equipment in a single patient area and include up to six each integral power receptacles and ground jacks.

Isolation Distribution Centers shall be a three-piece assembly consisting of: back box, component chassis, and front trim. For ease of installation, component chassis shall be pre-assembled, pre-wired, and shall contain isolation transformer, Line Isolation Monitor (LIM), primary main and total quantity of factory installed secondary branch circuit breakers as indicated on panel schedule(s).

Panels shall be single-phase with voltage and load ratings as indicated on panel schedule(s).

Enclosure depth shall be a maximum of six inches for units up to 10kVA.

Panels shall be flush mount. Back boxes shall be available for shipment during rough-in construction stage. Pre-wired component chassis and front trim shipped according to construction schedule.

Where contract drawings call for panels to be installed outside of the room being served, a Remote Annunciator Lifelink model DRA-1V connected to the Line Isolation Monitor shall be installed inside the room.

2.3 DUPLEX ISOLATION DISTRIBUTION PANEL

Provide Duplex Isolation Distribution Panels for all operating rooms and other critical procedure areas as indicated on contract drawings. Duplex Isolation Distribution Panels are intended to serve medical equipment in a single patient area where more than one system is required.

Duplex Isolation Distribution Panels shall contain two independent isolation systems, physically separated by a barrier. Panels shall be pre-assembled and pre-wired, and shall contain two each: isolation transformers, Line Isolation Monitors (LIM), primary mains and two sets of secondary branch circuit breakers factory installed as indicated on panel schedule(s).

Panels shall be single-phase with voltage and load ratings as indicated on panel schedule(s).

Enclosure depth shall be a maximum of six inches for units up to 10kVA for each isolated system.

Panels shall be flush mount. Back boxes shall be available for shipment during rough-in construction stage. Pre-wired component chassis and front trim shipped according to construction schedule.

Where contract drawings call for panels to be installed outside of the room being served, Remote Annunciators connected to the Line Isolation Monitors shall be installed inside the room.

PG LifeLink model IPX panels shall be basis for design.

2.4 LASER ISOLATION DISTRIBUTION PANEL

Provide Laser Isolation Distribution Panels to serve discrete device loads in multiple operating rooms and other critical procedure areas as indicated on contract drawings. Laser Isolation Panels serve 208-240V portable high-power equipment, such as medical lasers in several nearby patient areas from a centrally installed location.

Laser Isolation Distribution Panel device chassis shall be pre-assembled and pre-wired and shall contain: Line Isolation Monitor (LIM), programmable control system, primary main and total quantity of secondary branch circuit breakers and associated contactors as indicated on panel schedule(s).

System shall include contactor control system with programmable lock-out feature to protect against accidental shutdown or overload of primary main circuit breaker.

Panels shall be single-phase with voltage and load ratings as indicated on panel schedule(s).

Panels shall be flush mount. Back boxes shall be available for shipment during rough-in construction stage. Pre-wired component chassis, isolation transformer, and front trim shall be shipped according to construction schedule.

Each branch circuit being served by Laser Isolation Distribution Panel shall include a Laser Outlet Module for connection of equipment loads. Laser Outlet Modules shall be installed inside each procedure room and wired back to associated Laser Distribution Panel and indicated on project drawings. Modules shall include: 8”H x 12”W x 4”D steel backbox, stainless steel front trim panel with hinged door over NEMA . receptacle, door activated control switch, and Remote Annunciator connected to Line Isolation Monitor at associated Laser Isolation Distribution Panel.

PG LifeLink model IPL Panels with DLO-R Laser Outlet Modules shall be basis for design.

2.5 DUAL VOLTAGE ISOLATION DISTRIBUTION PANEL

Provide Dual Voltage Isolation Distribution Panels for all operating rooms and other critical procedure areas as indicated on contract drawings. Dual Voltage panels simultaneously serve both 120V medical equipment and 208-240V portable high-power equipment within a single procedure room from a single panel.

Dual Voltage Isolation Distribution Panels shall contain a single isolation transformer with a single input and dual output windings (120V and *208V*). Panels shall be pre-assembled and shall contain two Line Isolation Monitors (LIM), one primary main circuit breaker, and two sets of secondary branch circuit breakers as indicated on panel schedule(s).

Panels shall be single-phase with voltage and load ratings as indicated on panel schedule(s).

Enclosure depth shall be maximum twelve inches.

Panels shall be flush mount. Back boxes shall be available for shipment during rough-in construction stage. Pre-wired component chassis and front trim shipped according to construction schedule.

Where contract drawings call for panels to be installed outside of the room being served, a Remote Annunciator connected to the Line Isolation Monitor shall be installed inside the room.

PG LifeLink model IPD panels shall be basis for design.

2.6 COMPONENTS

Enclosure

1. Back-box shall be fabricated of galvanized steel in accordance with UL 50 and shall be flush mounted, unless indicated otherwise, at the elevation shown on the plans.

Front Trim

1. The front trim shall be constructed of stainless steel with a # 4 brushed finish, and shall be secured by 1/4-20 stainless steel screws
2. A lockable hinged door shall provide access to operate circuit breakers. The breaker access door shall not obscure the LIM(s) even when open.
3. Front trim shall include a full-length hinge along one side, allowing easy access during testing and maintenance without having to fully remove and realign trim.
4. Hinges shall be concealed type to facilitate regular cleaning/disinfecting of entire trim surface.

5. The maximum temperature rise at the surface of the front trim shall not exceed 30° C above room ambient under full load conditions.

Chassis

1. All Components within the isolation panel shall be mounted to a removable chassis plate and pre-wired using low leakage type XHHW-2 wire in accordance with UL requirements.
2. Barriers shall be included for separation of the incoming grounded primary feeder. Separation shall be maintained between grounded and ungrounded conductors.
3. A terminal block shall be provided for connection of remote signal conductors.

Hospital Grade Isolation Transformers

1. The Hospital Isolation Transformer shall be single phase, 60 Hz, with kVA rating, primary voltage, and secondary voltage(s) as indicated on the panel schedules and/or project drawings.
2. The isolation transformer shall be of stacked core design with an electrostatic shield between the primary and secondary windings to prevent direct shorting, and to reduce coupling of harmonic distortions between the windings. The shield shall be grounded to the enclosure. Core and coil shall be varnish impregnated and include a final wrap of insulating material to prevent exposure of bare conductors.
3. Total leakage current to ground from windings shall not exceed the values shown in Table 30.2 of UL Standard 1047.
4. The inherent regulation of the isolation transformer at rated input voltage shall be such that the difference between the output voltage at no load and the output voltage at rated current at unity power factor shall not exceed 3% of the output voltage at rated current per UL Standard 1047.
5. Transformer temperature rise shall be limited to 115° C above ambient at full load and shall not exceed the values indicated in Table 29.1 of UL 1047 when tested in accordance with UL 1047 Section 29.
6. Transformer shall be manufactured using a Class (220)R UL Recognized Insulation System, to thermally protect unit up 220° C.
7. Transformer shall be mounted to the enclosure using vibration isolating washers. Maximum design sound level of installed system shall not exceed 35 dBA.

Line Isolation Monitor (LIM)

1. Line Isolation Monitor shall continuously monitor the impedance from each isolated conductor to ground and shall display the Total Hazard Current (THC) of the system. The LIM shall be capable of detecting all combinations of resistive and capacitive faults whether they are balanced, unbalanced or hybrid.
2. LIM shall meet following performance specifications:
   a. Operating voltage 85 to 265 VAC (user selectable)
   b. Operating frequency 50/60 Hz
   c. Total Hazard Current (THC) range 0-5mA (user selectable for 0-2mA)
3. LIM shall be certified in accordance with UL Standard 1022 and CSA 22.2 No. 204.
4. Normal status of the LIM shall be indicated by illumination of a green "Safe" LED. An alarm signal shall be obtained when the Total Hazard Current (THC) reaches a threshold value of not more than 5.0 milliamperes (mA). Alarm state is indicated by illumination of a red "Hazard" LED and by an audible alarm as well. A silence button shall be provided to mute the audible alarm without extinguishing the visual alarm indication. A yellow LED will remain on while LIM is in the silenced mode. The LIM shall automatically reset to normal status when the fault condition is corrected.

5. LIM shall provide digital indication of the Isolated Power System's THC in units of mA. Unit shall also include a bar graph type display of THC scaled from 0 to 160% of the LIM's alarm point setting.
6. A momentary test switch shall be provided on the face of the LIM for periodic manual testing/calibration of the unit, as well as verification that all indicators and meters are operational. In addition, LIM shall automatically initiate a regularly scheduled self-test/calibration sequence at least once per day. Frequency of self-test shall be configurable by user in increments of 1 to 24 hours.
7. LIM shall contain a 2-Line (20 characters each row) LCD user interface screen that clearly displays the unit's current operating status, measured line-to-line voltage, present time, logged alarm data, and all user-configurable system settings.
8. The LIM shall signal an alarm if it detects that its connection to the isolation panel's reference ground bus is disconnected.
9. LIM shall include a wiring harness assembly for connection of remote mounted alarm annunciator unit(s).
10. In addition to driving optional remote annunciators, LIM shall include a SPDT relay contact for use with external alarm systems.
11. The PG LifeLink model Mark V shall be the basis for design.

Circuit Breakers

1. A main circuit breaker shall be provided on the primary line side of the isolation transformer. Breaker shall be 2-pole, thermal magnetic type, with minimum 10,000 AIC. Breaker shall be sized according to transformer voltage and kVA rating.
2. All branch circuit breakers shall be factory installed in isolation panel based on quantities and ratings shown on project panel schedule(s). Branch circuit breakers shall be 2-pole, bolt-on type only, with thermal magnetic trip and minimum 10,000 AIC. Maximum 16 each per isolation transformer.
3. All panelboard busbars shall be copper.
4. Isolated Power Panel shall accommodate panelboards/breakers manufactured by Eaton, General Electric, Siemens, and Schneider Electric.

Remote Annunciator

1. Where the layout drawings call for the isolated power panel to be installed outside of the operating room or patient care area being served, a remote annunciator shall be installed inside the room, or alternately at a continuously monitored area such as a nurse's station.
2. Remote LIM signal annunciators shall be supplied as indicated on layout drawings. Remote annunciators shall be compatible with system Line Isolation Monitor and shall provide visual and audible indication of LIM alarm status.
    a. Functions shall include: LED indicators for "SAFE" and "HAZARD" conditions, audible alarm with global "SILENCE" button, digital display of Total Hazard Current (THC) with bar graph, and remote "TEST" button to manual test/calibrate LIM from remote location. PG LifeLink Model DRA-1V shall be basis for design.

PART 3 - INSTALLATION

3.1 ASSEMBLY

Contractor shall review and follow all manufacturer's recommendations for proper handling, mounting, assembly, and wiring of equipment.

3.2 WIRING

All energized branch circuit conductors of the isolated power system shall be stranded copper having a cross-linked polyethylene insulation, or equivalent with a dielectric constant of 3.5 or

less. Type XHHW-2, 90°C is suitable for this purpose. Each branch circuit conductor shall be color-coded in accordance with NFPA 70 - National Electrical Code – Article 517.160. Isolated conductor L1 shall be orange and conductor L2 shall be brown. Each branch circuit conductor shall also contain a distinctive colored stripe (other than white, green, or gray) along the entire length of the wire.

Equipment grounding conductors shall be installed with each branch circuit in accordance with bonding requirements found in NFPA 70 - National Electrical Code – Article 517. Equipment grounding conductors shall be insulated type and green in color.

Wire pulling compound adversely affects the dielectric constant of conductor insulation and shall not be used when pulling the wire of the isolated power system. Use of dry talcum powder is permitted. No more than six wires in a ¾" conduit will be allowed.

Minimize length of conductor runs to the greatest extent possible to decrease accumulated leakage current. With all branch circuit wiring installed, system must be capable of passing minimum wiring impedance test requirement per NFPA 99 Section 6.3.2.6.2 (2012 Edition).

3.3 TEST AND CERTIFICATION

Contractor shall include the cost of and make all arrangements for testing of installed Isolation Panels by a qualified factory technician provided by the manufacturer of isolation systems.

Upon completion of the installation, the qualified factory technician shall inspect and test the equipment to verify that it is properly installed and operating as specified. All inspections and testing required by NFPA 99 Section 6.3.2.6 (2012 Edition) shall be performed.

A field test report and written certification that the system was installed and operating properly shall be furnished. The factory technician shall also instruct the hospital personnel in the proper use and maintenance of the equipment.

END OF SECTION 26 25 00

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Single and duplex receptacles, ground-fault circuit interrupters and isolated-ground receptacles.
2. Single- and double-pole snap switches.
3. Device wall plates.
4. Pin and sleeve connectors and receptacles.
5. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. PVC: Polyvinyl chloride.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Receptacles, switches, plates, floor outlets, poke through assemblies, service poles and multioutlet assemblier.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70 latest edition or edition enforced by state or local code authority.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Outlets - Duplex:
   a. Hubbell Incorporated- HBL 5362.
   b. Leviton Mfg. Company Inc.-5362.
   c. Pass & Seymour-CRB5362.
   d. Pass & Seymour -PT5362A (Plug Tail Device).

2. Outlets – Duplex: Hospital Grade
   a. Hubbell Incorporated- HBL 8300.
   b. Leviton Mfg. Company Inc.-8300
   c. Pass & Seymour-PS8300.
   d. Pass & Seymour -PT8300.

3. Switches-Single Pole:
   a. Hubbell- HBL 1221.
   b. Pass & Seymour - PS20AC1.
   c. Leviton Mfg. Company, Inc.- 1221-1

4. Switches-Three Pole:
   a. Hubbell- HBL1223
   b. Leviton Mfg. Company, Inc.-1223-2.
   c. Pass & Seymour-PS20AC3.

5. Dimmer Switches Line Voltage:
   a. Lutron Nova T
   b. Pass & Seymour CD2000

* Dimmer must be compatible with Ballast or LED Driver.

6. Dimmer Switches 0-10V:
   a. Synergy ISD
   b. Cooper SF10P

* Dimmer must be compatible with Ballast or LED Driver.

7. GFI Receptacles: Weather Resistant:
   a. Hubbell Incorporated- BR20WR
   b. Leviton Mfg. Company Inc.-WBR20
   c. Pass & Seymour- WR5362.

8. GFI Receptacles: Weather Resistant and Tamper Resistant:
   a. Hubbell Incorporated- BR2WRTR.
   b. Leviton Mfg. Company Inc.-TWR20

c. Pass & Seymour- WR20TR.

9. GFI Receptables: Hospital Grade
   a. Hubbell Incorporated – GF8300
   b. Leviton Mfg. Company, Inc. – GF8300
   c. Pass & Seymour = TR63H

10. Receptacles: Tamper Resistant
   a. Hubbell Incorporated- BR20TR.
   b. Leviton Mfg. Company Inc.-TWR20
   c. Pass & Seymour- TR5362.

11. Receptables Tamper Resistant: Hospital Grade
   a. Hubbell-8300SG
   b. Leviton Mfg. Company, Inc. – 8300SG
   c. Pass & Seymour – TR63H

2.2 RECEPTACLES

A. Straight-Blade-Type Receptacles: Comply with UL 498, 20 amp.

B. Straight-Blade and Locking Receptacles: Heavy-Duty grade 20 amp.

C. GFCI Receptacles: Straight blade, feed-through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.

D. Hospital grade in all patient locations.

E. Hospital grade and tamper resistant in all pediatric and public areas. GFI receptacles do not have to be tamper resistant.

2.3 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.4 SWITCHES

A. Single- and Double-Pole Switches: Comply with UL 20, 20 amp.

B. Snap Switches: Heavy-Duty grade, quiet type 20 amp, 120/277 volt.

C. Live Voltage Dimmer: 120V, 2000 watt, slide to-off. Dimmer must be compatible with ballast or driver.

D. 0-10V Dimmer: 120/277VAC, capable of three way, max wattage 1200 w 120VAC, 150000 277 VAC, Dimmer must be compatible with ballast or driver. 100% to 1% continuous.

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: **As selected by Architect**.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Wet Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

2.6 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Recessed type with three (3) compartments that allow for up to three (3) duplex receptacles and/or 12 communication ports and/or 10 AV devices.
2. Size: Selected to fit nominal 6-inch (100-mm) cored holes in floor and matched to floor thickness.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
4. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors; and a minimum of four, 4-pair, Category 6 voice and data communication cables.

2.7 FINISHES

A. Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70.2.
2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

C. Remove wall plates and protect devices and assemblies during painting.

D. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

E. Install weather resistant receptacles in damp and wet locations per N.E.C. requirements.

F. Install tamper resistant receptacles in homes, apartments, hotel rooms and daycares per N.E.C. requirements.

3.2 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600 V and less for use in switches.

1.3 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Fuse size for elevator feeders and elevator disconnect switches.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ferraz Shawmut, Inc.
2. Little Fuse.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

B. End Caps: End caps shall be capable of being tested if fuse is blown.

C. Indicating Feature: Fuse shall have an indicating feature which clearly indicates when fuse is blown.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Motor Branch Circuits: Class RK1, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 26 28 13

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:

1. Feeder and branch-circuit protection.
2. Motor and equipment disconnecting means.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. RMS: Root mean square.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings,
and finishes.

B. Shop Drawings: For each switch and circuit breaker.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Current and voltage ratings.
c. Short-circuit current rating.
d. UL listing for series rating of installed devices.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

3. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70- Latest edition or edition enforced by state and local code authority.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Fusible Switches:

a. Eaton Corp.; Cutler-Hammer Products, K-Series.
b. General Electric Co.; Electrical Distribution & Control Division, TH.
c. Siemens Energy & Automation, Inc., VBII.
d. Square D Co, 3110.

2.2 ENCLOSED SWITCHES

A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

2.3 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.4 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in "Basic Electrical Materials and Methods."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

C. If the disconnect or enclosed circuit breaker is used as a Main Service Disconnect then the maximum available fault current shall be listed on the device to meet the requirements of NFPA 70:110.24. The labeling shall be engraved plastic. The maxiumum available fault current shall be obtained from the electrical utility for the secondary side of the utility transformer.

3.3 CONNECTIONS

A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.

B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

D. Maintain all necessary clearances per NFPA-70.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
2. Test continuity of each line- and load-side circuit.

3.5 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 28 16

SECTION 26 32 13 – PACKAGED ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged diesel-engine generator sets with the following features and accessories:

1. Battery charger.
2. Engine generator set.
3. Muffler.
4. Outdoor enclosure.
5. Remote annunciator.
6. Remote stop switch.
7. Starting battery.
8. Subbase fuel tank.
9. Transfer switch.
10. Fuel filtration system.

B. Related Sections include the following:

1. Section "Transfer Switches" for transfer switches, including sensors and relays to initiate automatic-starting and -stopping signals for engine generator sets.

1.3 DEFINITIONS

A. Standby Rating: Power output rating equal to the power the generator set delivers continuously under normally varying load factors for the duration of a power outage.

B. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

C. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control test reports.

1. Certified summary of prototype-unit test report.
2. List of factory tests to be performed on units to be shipped for this Project.

3. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA 110 level 1.
4. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations. Generator sets must be engine-manufacturer certified EPA Emergency.

B. Warranty:
1. Submit manufacturer's warranty statement to be provided for this Project. Warranty shall be for a minimum of five years from date of commissioning; and shall include all components, service time, and travel costs with no deductibles. Warranties from individual component suppliers are not acceptable.

2. The generator set manufacturer shall be the sole source of warranty support for all the generator and associated accessories. The generator set supplier shall provide binding warranty documents that cover the entire generator power system. There shall not be separate warranties for the engine or alternator.

3. Warranty to include service personnel shall arrive on site within 4 hours.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Provide documentation demonstrating ability of the voltage regulation system to operate with stable voltage regardless of the level of distortion present on the alternator.
3. Time-current characteristic curves for generator protective device.
4. Sound test data, based on actual tests of the generator set model proposed in a free field environment; or alternately, an anechoic chamber.

B. Shop Drawings: Indicate fabrication details, dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Detail wiring for power and control connections and differentiate between factory-installed and field-installed wiring.
2. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

C. Field Test and Observation Reports: Indicate and interpret test results and inspection records relative to compliance with performance requirements.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain packaged engine generator and auxiliary components specified in this Section through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

C. Comply with NFPA 70.

D. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

E. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is safe from such hazards.

1.8 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Extended Warranty: Manufacturer shall provide extended warranty coverage on the material and workmanship of the generator set for a minimum of five years from registered commissioning and start-up. The warranty shall cover 100% of costs warranty repairs with no deductibles.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cummins
2. Kohler
3. Caterpillar
4. MTU

2.2 ENGINE GENERATOR SET

A. Furnish a coordinated assembly of compatible components.

B. Voltage: 480/277V Three phase, four wire.

C. Nameplates: Each major system component is equipped with a conspicuous nameplate of component manufacturer. Nameplate identifies manufacturer of origin and address, and model and serial number of item.

D. Limiting dimensions indicated for system components are not exceeded.

E. Power Output Ratings: Nominal rating is **1250** kW for standby operation, at 80 percent lagging power factor based on site conditions of 50 degrees C and altitude of 30 feet above sea level.

Performance of the generator set shall be demonstrated by documentation from the engine and alternator manufacturers describing basic performance and derating factors. Test results of the generator set package with the specific cooling system, engine and alternator model at maximum site ambient shall be required to document this capability. The alternator shall provide a minimum of 4,440 sKVA at an instantaneous voltage dip of 30%. Sustained voltage dip is not acceptable. Provide factory documentation of compliance with these requirements.

F. Skid: Adequate strength and rigidity to maintain alignment of mounted components without depending on a concrete foundation. Skid is free from sharp edges and corners. Lifting attachments are arranged to facilitate lifting with slings without damaging any components.

2.3 GENERATOR-SET PERFORMANCE

A. Steady-State Voltage Operational Bandwidth: 4 percent of rated output voltage from no load to full load.

B. Steady-State Voltage Modulation Frequency: Less than 1 Hz.

C. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage recovers to remain within the steady-state operating band within three seconds.

D. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

E. Steady-State Frequency Stability: When system is operating at any constant load within rated load, there are no random speed variations outside the steady-state operational band and no hunting or surging of speed.

F. Transient Frequency Performance: Less than 5 percent variation for a 50 percent step-load increase or decrease. Frequency recovers to remain within the steady-state operating band within five seconds.

G. Output Waveform: At no load, harmonic content measured line to line or line to neutral does not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.

H. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, the system will supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to any generator system component.

I. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.4 SERVICE CONDITIONS

A. Environmental Conditions: Engine generator system withstands the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 15 to plus 50 deg C.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 30 feet.

B. Exhaust Emissions: The generator set shall be certified by the engine manufacturer as suitable for use in EPA-Stationary Emergency applications.

2.5 ENGINE

A. Comply with NFPA 37.

B. Fuel: **Diesel**

C. Rated Engine Speed: 1800 rpm, 4 cycle.

D. Lubrication System: Pressurized by a positive-displacement pump driven from engine crankshaft. The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Controls flow in system to maintain optimum oil temperature. Unit is capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps or siphons or special tools or appliances.

E. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment.

F. The Generator set manufacture shall also be the engine manufacture.

2.6 GOVERNOR

A. Type: Adjustable isochronous, with speed sensing.

2.7 ENGINE COOLING SYSTEM

A. Description: Closed loop, liquid cooled, with radiator factory mounted on engine generator-set skid and integral engine-driven coolant pump.

B. Radiator: Rated for specified coolant.

C. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

D. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

2.8 ENGINE EXHAUST SYSTEM

A. Muffler: Critical type. Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For outdoor applications, the silencer provided shall be sufficient to reduce the exhaust noise to a

level less than the mechanical noise of the installation. Muffler to be internal to generator set enclosure.

B. Connections from Engine to Exhaust System: Flexible section of corrugated stainless-steel pipe.

C. Connection from Exhaust Pipe to Muffler: Stainless-steel expansion joint with liners.

D. Insulation for Mufflers and Indoor Exhaust Piping: As specified in Section "Pipe Insulation."

E. Supports for Muffler and Exhaust Piping: Spring hangers and all-thread rods and vibration hangers as specified in Section "Mechanical Vibration Controls and Seismic Restraints"; attached to building structure.

F. Exhaust Piping External to Engine: ASTM A 53, Schedule 40, welded, black steel, with welded joints and fittings. Refer to Section "Basic Mechanical Materials and Methods" for basic piping installation and joint construction. Refer to Section "Hydronic Piping" for materials and installation requirements for piping.

2.9 COMBUSTION-AIR-INTAKE

A. Description: Standard-duty engine-mounted air cleaner with replaceable dry filter element and "blocked filter" indicator.

2.10 STARTING SYSTEM

A. Description: 24-V electric, with negative ground and including the following items:

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Environmental Conditions" Paragraph in "Service Conditions" Article above.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Cranking Cycle: 60 seconds.
5. Battery: Adequate capacity within ambient temperature range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article above to provide specified cranking cycle at least three times without recharging.
6. Battery Cable: Size as recommended by generator set manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit complies with UL 1236 and includes the following features:

    a. Operation: Equalizing-charging rate of 10 A is initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit then automatically switches to a lower float-charging mode and continues operating in that mode until battery is discharged again.
    b. Ammeter and Voltmeter: Flush mounted in door. Meters indicate charging rates.
    c. Safety Functions: Include sensing of abnormally low battery voltage arranged to close contacts providing low battery voltage indication on control and monitoring panel. Also include sensing of high battery voltage and loss of ac input or dc

output of battery charger. Either condition closes contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

d. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.11 CONTROL AND MONITORING

A. Functional Description: When the mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic-transfer switches initiate starting and stopping of the generator set. When the mode-selector switch is switched to the on position, the generator set manually starts. The off position of the same switch initiates generator-set shutdown. When the generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down the generator set.

B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages are grouped on a common control and monitoring panel mounted on the generator set. Mounting method isolates the control panel from generator-set vibration.

C. Indicating and Protective Devices and Controls: Include those required by NFPA 110 for a Level 1 system, and the following:

D. Indicating and Protective Devices and Controls: Include the following:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch (es).
9. Generator-voltage adjusting rheostat.
10. Start-stop switch.
11. Overspeed shutdown device.
12. Coolant high-temperature shutdown device.
13. Coolant low-level shutdown device.
14. Oil low-pressure shutdown device.
15. Generator overload.

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items on engine, generator, or elsewhere as indicated. Where not indicated, locate to suit manufacturer's standard.

F. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Locate audible device and silencing means where indicated. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Engine high-temperature shutdown.
2. Lube-oil low-pressure shutdown.
3. Overspeed shutdown.
4. Remote emergency-stop shutdown.
5. Engine high-temperature prealarm.
6. Lube-oil low-pressure prealarm.

7. Overcrank shutdown.
8. Coolant low-temperature alarm.
9. Control switch not in auto position.
10. Battery-charger malfunction alarm.
11. Battery low-voltage alarm.

G. Remote Alarm Annunciator: Comply with NFPA 99. Labeled LEDs identify each alarm event. Common audible signal sounds for alarm conditions. Silencing switch in face of panel silences signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

H. Connect to the building Energy Management System for monitoring. Monitor voltage, on/off, line in and line out.

I. Remote Emergency-Stop Switch: Provide a loose, flush-wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation. Installation of the switch shall be completed by others at a location as indicated on the drawings.

2.12 GENERATOR OVERCURRENT AND FAULT PROTECTION

C. Generator Overcurrent Protection: The generator set shall be provided with a UL Listed/CSA Certified protective device that is coordinated with the alternator provided to prevent damage to the generator set on any possible overload or overcurrent condition external to the machine. The protective device shall be listed under UL category NRGU. The control system shall be subject to UL follow-up service at the manufacturing location to verify that the protective system is fully operational as manufactured. Generator overcurrent protection based on category FTPM will not be accepted. A circuit breaker is not suitable for this function. Protector shall perform the following functions:
1. Initiates a generator kW overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
2. Under single phase or multiple phase fault conditions, or on overload conditions, indicates an alarm conditions when the current flow is in excess of 110% of rated current for more than 10 seconds.
3. Under single phase or multiple phase fault conditions, operates to switch off alternator excitation at the appropriate time to prevent damage to the alternator.
4. The over current protection will be logically interlocked with the balance of the AC protection devices so that the generator set is capable of operating for the duration of any single or multiple phase fault condition until the overcurrent protection operates. Provide documentation demonstrating that the overcurrent protection provided protects the alternator provided. This documentation shall include an alternator thermal damage curve plotted against the actual trip characteristic of the overcurrent protection equipment.
5. The protective system shall be designed to prevent overvoltage conditions that are due to any overcurrent condition in the loads.
6. The operator panel shall indicate the nature of the fault condition as either a short circuit or an overload.
7. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot greater than 115% of nominal voltage.
8. The protective system provided shall not include an instantaneous trip function.

D. AC protection shall include over/under voltage, over/under frequency, reverse power (kW), reverse var, negative sequence overcurrent, and loss of AC bus reference voltage. All settings shall be adjustable from the generator set operator panel.

E. Ground-Fault Indication: Comply with NFPA 70 requirements for ground-fault alarm or shutdown. Integrate ground-fault alarm indication with other generator-set alarm indications. Ground fault sensing for the generators shall be located at the neutral to ground bonding point

F. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Matched to generator thermal damage curve as closely as possible.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.13 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1 and specified performance requirements.

B. Drive: Generator shaft is directly connected to engine shaft. Exciter is rotated integrally with generator rotor.

C. Electrical Insulation: Class H.

D. Temperature Rise 125C over a 40C environment.

E. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

F. Construction prevents mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Excitation uses no slip or collector rings, or brushes, and is arranged to sustain generator output under short-circuit conditions as specified.

H. Enclosure: Drip proof.

I. Instrument Transformers: Mounted within generator enclosure.

F. Voltage Regulator: Digital, separate from exciter, to provide transient and steady state performance as specified. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated power supply to the exciter. The voltage regulator shall be located in a listed control cabinet.

1. The digital voltage regulation system shall be matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load induced voltage waveform.

2. The voltage regulation system shall be equipped with three phase line to neutral RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot.

3. The system shall include a torque matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field.

4. The voltage regulator shall include adjustments for gain, damping, and frequency roll off that are accessible from the generator set control panel without exposing an operator to dangerous voltage levels. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
5. The voltage regulation system shall include a maintenance mode function; which, when enabled, causes the excitation system to immediately shut down when an overcurrent condition in excess of 300% of rated current occurs.

    a. The control shall operate to disable the excitation system in 50 milliseconds or less.
    b. Enabling the maintenance mode shall cause the control system to record date and time the condition occurred, display a warning message on the operator panel, and provide a signal for display the condition at all remote annunciation points.

6. The voltage regulation system shall provide a stable voltage output regardless of the level of distortion present on the connected loads.

G. The alternator shall be provided with anti-condensation heater(s) in all applications where the generator set is provided in an outdoor enclosure, or when the generator set is installed in a coastal or tropical environment.

H. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

I. Subtransient Reactance: 12 percent, maximum.

2.14 OUTDOOR GENERATOR-SET ENCLOSURE

A. The generator set shall be provided with a custom, walk-in style, outdoor enclosure. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 76dBA at any location 7 meters from the generator set in a free field environment. The enclosure shall be insulated with non-hydroscopic materials. Housing shall provide ample airflow for generator set operation at rated load in an ambient temperature of 50 degrees C.

B. The package shall comply with the requirements of the National Electrical Code for all wiring materials and component spacing. The total assembly of generator set and enclosure shall be designed to be lifted into place using spreader bars. The housing shall have hinged access doors as required to maintain easy access for all operating and service functions. All doors shall be lockable, and include retainers to hold the door open during service. Enclosure roof shall be cambered to prevent rainwater accumulation. Openings shall be screened to limit access of rodents into the enclosure. All electrical power and control interconnections shall be made within the perimeter of the enclosure. Enclosure manufacturer shall include a pre-wired distribution panel for all generator-set auxiliaries as well enclosure A/C lighting, switches, and GFCI receptacles. Battery back-up DC lighting shall also be provided and installed within the generator set enclosure by the enclosure manufacturer.

1. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a powder coat paint process, or equal. All surfaces of all metal parts shall be primed and painted.
2. Enclosure shall be constructed of aluminum and be rated for 150 MPH winds. All hardware and hinges shall be stainless steel.
3. A factory-mounted exhaust silencer shall be installed internal to the enclosure. Exhaust connections to the generator set shall be through seamless flexible connections.

4. Enclosure is to be walk-in style construction. Skin-tight or “standard” construction is not acceptable. A minimum of 36” clearance from the frame shall be provided along the sides of the generator set, excluding batteries and radiator, and a minimum of 42” clearance in front of the main alternator. Enclosure manufacturer shall submit clearances around generator set to verify compliance.

C. Generator Set Sub-Base Fuel Tank

Provide a double walled, corrosion resistant steel, sub-base fuel storage tank with a minimum 96-hour full genset rated load capacity. Tank to have structural integrity to support genset and its accessories and be furnished with mounting hardware and fuel connections. Furnish a low fuel level alarm switch and leak detection alarm switch, both wired to annunciator lights on generator control panel. Tank to be UL 2085 labeled with required emergency vent and lockable fill cap. Fuel polishing system shall be provided and wired to generator panel. Fuel required for testing and filling, prior to placing the genset into service and after unit has been successfully tested, shall be furnished and installed by Owner. Contractor shall coordinate with Owner for fuel delivery schedule. Should multiple iterations of testing be required prior to placing genset into service, successive delivery charges shall be passed to Contractor at Owner’s established third-party rates.

Provide aluminum work platform(s) with quantity of steps as required to access controls depending on height of fuel tank. Platform(s) shall be provided with minimum 36” wide steps and a platform properly sized to allow access to controls compartment of the generator. Minimum stair/platform capacity shall be 500 pounds. Materials of construction shall match that of enclosure. Orientation to be coordinated with proposed field installation as indicated in Plans. Shop drawings shall be submitted for review and approval along with field measurements to validate proposed installation. Contractor shall prepare all adjacent surfaces, as may be required, to facilitate installation in accordance with manufacturer’s shop drawings. No additional payment shall be considered for additional hard surface pavement required to conform to manufacturer’s installation requirements.

D. Fuel Filtration System

Fuel Filtration System. Provide a fuel filtration system mounted within the generator enclosure. The fuel filtration system shall filter the sub-base fuel tank. The fuel filtration system shall be AXI International STS 7004 or prior approved equivalent. Integrate fuel filtration system with generator control and monitoring system for remote communication of system status and alarms. Provide all piping and valves per plumbing code.

2.15 FUEL SUPPLY SYSTEM

A. Comply with NFPA 30 and NFPA 37.

2.16 VIBRATION ISOLATION DEVICES

A. Vibration Isolation: Generators installed on grade shall be provided with elastomeric isolator pads integral to the generator, unless the engine manufacturer requires use of spring isolation.
   1. IBC Compliance: Isolators complying with IBC requirements shall be specified in the equipment documentation, as well as the installation requirements for the unit.

2.17 FINISHES

A. Indoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

B. Outdoor Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer. Color by Architect.

2.18 SOURCE QUALITY CONTROL

A. Factory Tests: Include prototype testing and Project-specific equipment testing (testing of equipment manufactured specifically for this Project).

B. Prototype Testing: Performed on a separate engine generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with those required for Level 1 energy converters in Paragraphs 3.2.1, 3.2.1.1, and 3.2.1.2 of NFPA 110.
2. Generator Tests: Comply with IEEE 115.
3. Components and Accessories: Items furnished with installed unit that are not identical to those on tested prototype have been tested to demonstrate compatibility and reliability.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment foundations, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine roughing-in of cooling-system piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.

3.2 CONCRETE BASES

A. Install concrete bases of dimensions indicated for packaged engine generators. Refer to "Cast-in-Place Concrete" and "Basic Electrical Materials and Methods."

3.3 INSTALLATION

A. Comply with packaged engine generator manufacturers' written installation and alignment instructions, and with NFPA 110.

B. Set packaged engine generator set on concrete bases.

C. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

D. Install cooling-system piping, accessories, hangers and supports, and anchors for complete installation.

1. Extend drain piping from heat exchangers to point of disposition.

E. Install exhaust-system piping for natural gas engines. Extend to point of termination outside structure. Size piping according to manufacturer's written instructions.

F. Install condensate drain piping for natural gas engine exhaust system. Extend drain piping from low points of exhaust system and from muffler to condensate traps and to point of disposition.

G. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

1. Verify that electrical wiring is installed according to manufacturers' submittal and installation requirements. Proceed with equipment startup only after wiring installation is satisfactory.

3.4 CONNECTIONS

A. Electrical wiring and connections are specified in other Sections.

B. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.5 IDENTIFICATION

A. Identify system components according to "Electrical Identification."

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to assist in testing. Report results in writing.

B. Testing: Perform field quality-control testing under the supervision of the manufacturer's factory-authorized service representative.

C. Tests: Include the following:

1. Tests recommended by manufacturer.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, the following:

a. 2 Hour Single-step full-load pickup test with resistor bank. Contractor to provide load bank.

3. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
4. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.

D. Coordinate tests with tests for transfer switches and run them concurrently.

E. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

F. Refill tank to full after testing.

3.7 CLEANING

A. On completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators as specified below:

1. Coordinate this training with that for transfer switches.
2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
3. Review data in maintenance manuals. Refer to "Contract Closeout."
4. Review data in maintenance manuals. Refer to Section "Operation and Maintenance Data."
5. Schedule training with Owner, through Architect, with at least seven days' advance notice.
6. Minimum Instruction Period: Eight hours.

END OF SECTION 26 32 13

SECTION 26 36 00 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switch.
2. Bypass/Isolation switch.

1.2 SUBMITTALS

A. Product Data: Include ratings and dimensioned plans, sections, and elevations showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

B. Wiring Diagrams: Detail wiring for transfer switches and differentiate between manufacturer-installed and field-installed wiring. Show both power and control wiring.

C. Single-Line Diagram: Show connections between transfer switch, bypass/isolation, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

D. Product Certificates: Signed by manufacturer certifying that products furnished comply with requirements and that switches have been tested for load ratings and short-circuit closing and withstand ratings applicable to units for Project.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

F. Field Test Reports: Indicate and interpret test and inspection results for compliance with performance requirements.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing emergency maintenance and repairs at Project site with an four-hour maximum response time.

B. Source Limitations: Obtain automatic transfer switch, nonautomatic transfer switch, remote annunciators, and remote annunciator and control panels through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for emergency service under UL 1008, by a testing agency acceptable to authorities having jurisdiction.

D. Comply with NFPA 70.

E. Comply with NFPA 99.

F. Comply with NFPA 110.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Conventional Transfer Switches:

a. ASCO
b. Cummins.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Solid-State Controls: Repetitive accuracy of all settings is plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

C. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

D. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral are double nominal rating of circuit in which switch is installed.

E. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6; UL 508, unless otherwise indicated.

F. Factory Wiring: Train and bundle factory wiring and label consistent with Shop Drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.

1. Designated Terminals: Pressure type suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

G. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

H. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units rated 225 A and greater have separate arcing contacts.

I. Transfer switch shall be manufactured shall be manufactured by the same manufacture of the generator set.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Signal-before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

D. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

E. Provide transfer switch with poles as indicated on the drawings.

2.4 AUTOMATIC TRANSFER-SWITCH FEATURES

A. Undervoltage Sensing for Each Phase of Normal Source: Senses low phase-to-ground voltage on each phase. Pickup voltage is adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

B. Time delay for override of normal-source voltage sensing delays transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

C. Voltage/Frequency Lockout Relay: Prevents premature transfer to generator set. Pickup voltage is adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency is adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

D. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes; factory set for 10 minutes. Provides automatic defeat of delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

E. Test Switch: Simulates normal-source failure.

F. Switch-Position Pilot Lights: Indicate source to which load is connected.

G. Source-Available Indicating Lights: Supervise sources via transfer-switch, normal- and emergency-source sensing circuits.

1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
2. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

H. Unassigned Auxiliary Contacts: Two normally open single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

I. Engine Starting Contacts: One isolated, normally closed and one isolated, normally open, rated 10 A at 32-V dc minimum.

J. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes; factory set for five minutes. Initiates shutdown at remote engine-generator controls after retransfer of load to normal source.

K. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine-generator set and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

1. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
2. Push-button programming control with digital display of settings.
3. Integral battery operation of time switch when normal control power is not available.

L. Bypass/Isolation Switches

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Comply with requirements for Level 1 equipment according to NFPA 110.
3. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

d. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. Interlocks shall prevent transfer-switch operation, except for testing or maintenance, while automatic transfer switch is isolated.
e. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.
f. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations. Transfer switch and bypass/isolation switch shall be in isolated compartments.
g. Transition:
   1) Provide open transition operation when transferring between power sources.

h. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
i. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
j. Automatic Control: Constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations in 15 seconds or less. Operating handles shall be externally operated.
k. Automatic and Nonautomatic Control: Automatic transfer-switch controller shall also control the bypass/isolation switch.
l. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
m. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

4. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.5 FINISHES

A. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

2.6 DOCKING STATION

A. Provide a dual purpose, single breaker docking station with male and female CamLoks to connect a load bank and temporary power source with the following standard features and listings:
   1. Factory installed phase rotation monitor
   2. All aluminum NEMA 3R construction
   3. Multiple interlock options available via manual, automatic breaker, or Kirk Key interlock configurations
   4. Patented tamper-resistant rake system to prevent cable theft and unauthorized disconnection
   5. Industry standard 16 Series CamLok connections compatible with any rental generator or load bank
   6. Listed to UL 1008 standards
   7. UL 50 listed enclosure
   8. NEC 700.3F compliant by application
   9. NEC 702.12C compliant with safety interlock door adder.

B. Manufacture and Model: Trystar SBDS-25-5-P-L-M-M-J-K-R or approved equal.

2.7 SOURCE QUALITY CONTROL

A. Factory Test Components, Assembled Switches, and Associated Equipment: Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 APPLICATION

A. Four-Pole Switches: Switching of line and neutral conductors.

3.2 INSTALLATION

A. Floor-Mounted Switch: Level and anchor unit to floor.

B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

C. Identify components according to "Electrical Identification."

3.3 WIRING TO REMOTE COMPONENTS

A. Match type and number of cables and conductors to control and communications requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

3.4 CONNECTIONS

A. Ground equipment as indicated and as required by NFPA 70.

3.5 FIELD QUALITY CONTROL

A. Testing: Test transfer-switch products by operating them in all modes. Perform tests recommended by manufacturer under the supervision of manufacturer's factory-authorized service representative. Correct deficiencies and report results in writing. Record adjustable relay settings.

B. Testing: Perform the following field quality-control testing under the supervision of the manufacturer's factory-authorized service representative in addition to tests recommended by the manufacturer:

1. Before energizing equipment, after transfer-switch products have been installed:

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage; proper installation and connection; and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
    f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown sequence.

C. Coordinate tests with tests of generator plant and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean equipment internally, on completion of installation, according to manufacturer's written instructions.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain transfer switches and related equipment as specified below:

1. Coordinate this training with that for generator equipment.
2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
3. Review data in maintenance manuals. Refer to "Contract Closeout."
4. Review data in maintenance manuals. Refer to "Operation and Maintenance Data."
5. Schedule training with Owner, through Architect, with at least seven days' advance notice.
6. Provide a minimum of four hours of instruction.

END OF SECTION 26 36 00

SECTION 26 43 13 - SURGE PROTECTION DEVICES FOR SERVICE ENTRANCE AND BRANCH PANELS

PART 1 - GENERAL

1.1 DESCRIPTION/SCOPE

A. The Surge Protection Device (SPD) covered under this section includes all service entrance type surge protection devices suitable for use as Type 1 or Type 2 devices per UL1449 4th Edition, applied to the line or load side of the utility feed inside the facility.

B. A SPD located at Service Entrance and Distribution and Branch Panels, Switchgear, Motor Control Centers, and Switchboard assemblies as indicated on the drawings.

C. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to finish and install surge protection devises.

1.2 QUALITY ASSURANCE

A. Reference Standard: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise stated in this document:

1. UL 1449 4th Edition.
2. UL 1283.
3. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
4. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.
5. UL96A
6. IEEE 1100 Emerald Book.
7. National Fire Protection Association (NFPA 70: National Electrical Code).

1.3 SUBMITTALS/QUALITY ASSURANCE – SUBMIT THE FOLLOWING:

A. Package must include shop drawings complete with all technical information, unit dimensions, detailed installation instructions, maintenance manual, recommended replacement parts list and wiring configuration.

B. Copies of Manufacturer’s catalog data, technical information and specifications on equipment proposed for use.

C. Copies of documentation stating that the Surge Protection Device is listed by UL to UL1449 4th Edition, category code VZCA.

D. Copies of actual let through voltage data in the form of oscillograph results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C6245.

E. Copies of Noise Rejection testing as outlined in NEMA LS1-1992 (R2000) Section 3.11. Noise rejection is to be measured between 50 kHz and 100 MHz verifying the devices noise attenuation. Must show multiple attenuation levels over a range of frequencies.
F. Copies of test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on a per mode basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.

G. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURER FOR ***TYPE C SPD's for Service Entrance Application:***

A. Current Technology – Transguard3 or TG3 Series **150kA** per mode surge rating or ASCO 560 series.

B. Approved equivalent. Submission package must be received by engineer 2 weeks prior to bid date shall fully comply with all performance characteristics included in this specification.

2.2 MANUFACTURED UNITS/ ELECTRICAL REQUIREMENTS

A. Refer to drawing for operating voltage, configuration and surge current capacity per mode for each location, or you may list locations and information here.

B. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449 4th Edition, section 37.7.3. MCOV values claimed based on the component's value or on the 30-minute 115% operational voltage test, section 38 in UL1449 will not be accepted.

C. Unit shall have no more than 10% deterioration or degradation of the UL1449 4th Edition Voltage Protection Rating (VPR) when exposed to a minimum of 5,000 repeated category C3 (20kV/10kA) surges. The SPD manufacturer must provide a test report validating the repetitive surge test was performed.

D. Protection Modes UL1449 4th Edition VPR(6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449 4th Edition section 37.6:

System Voltage	Mode	MCOV	B3 Ringwave 6kV, 500A	C3 Comb. Wave 20kV, 10kA	UL 1449 Third Edition VPR Rating
120/240, 120/208	L-N	150	490	980	700
	L-G	150	570	980	700
	N-G	150	640	1170	700
	L-L	300	500	1600	1200
277/480	L-N	320	450	1420	1200
	L-G	320	540	1540	1200
	N-G	320	570	1600	1000
	L-L	552	530	2600	2000

E. Electrical Noise Filter- each unit shall include a high performance EMI/RFI noise rejection filter with a maximum attenuation of 54dB per MIL-STD-220B.

1. SPD shall include an EMI/RFI noise rejection filter for all L-N modes as well as a removable filter in the N-G mode.

F. Integral Disconnect Switch (IF REQUIRED)

1. The device shall have an optional NEMA compliant safety interlocked integral disconnect switch with an externally mounted metal manual operator.
2. The switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption to the facility's distribution system.
3. The switch shall be rated for 600Vac.
4. The SPD device shall be tested to UL1449 4th Edition listed with the integral disconnect switch and the UL1449 VPR ratings shall be provided.
5. The integral disconnect switch shall be capable of withstanding, without failure, the published maximum surge current magnitude without failure or damage to the switch.
6. The line side of the integral disconnect shall be blocked off so that when the SPD is opened there is no direct access to the voltage present on the line side of the disconnect.

G. The UL1449 Voltage Protective Rating (VPR) shall be permanently affixed to the SPD unit.

H. The UL1449 Nominal Discharge Surge Current Rating shall be 20Ka

I. The SCCR rating of the SPD shall be 200kAIC without the need for upstream over current protection.

J. The SPD shall be listed as Type1 SPD, suitable for use in Type1 or Type2 applications.

K. The SPD shall have the following monitoring options.

1. Time Date stamp, duration and magnitude for the following power quality events (sags, swells, surges, dropouts, outages, THD, frequency, Volts RMS per phase)
2. SPD monitoring shall track surge protection and display it as a percentage
3. SPD shall provide a surge counter with three categories to be defined as Low Level surge (100A-500A) Medium Level surge (500A-3,000A) High Level surge (>3,000A)

2.3 APPROVED MANUFACTURER FOR ***TYPE B SPD's for Branch Panel Application:***

A. Current Technology – Transguard3 or TG3 Series 50 **kA** per mode surge rating or ASCO 560 series.

B. Approved equivalent. Submission package must be received by engineer 2 weeks prior to bid date shall fully comply with all performance characteristics included in this specification.

2.4 MANUFACTURED UNITS/ ELECTRICAL REQUIREMENTS

A. Refer to drawing for operating voltage, configuration and surge current capacity per mode for each location, or you may list locations and information here.

B. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449 4th Edition, section 37.7.3. MCOV values claimed based on the component's value or on the 30-minute 115% operational voltage test, section 38 in UL1449 will not be accepted.

C. Unit shall have no more than 10% deterioration or degradation of the UL1449 4th Edition Voltage Protection Rating (VPR) when exposed to a minimum of 5,000 repeated category C3 (20kV/10kA) surges. The SPD manufacturer must provide a test report validating the repetitive surge test was performed.

D. Protection Modes UL1449 4th Edition VPR(6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449 4th Edition section 37.6:

System Voltage	Mode	MCOV	B3 Ringwave 6kV, 500A	C3 Comb. Wave 20kV, 10kA	UL 1449 Third Edition VPR Rating
120/240, 120/208	L-N	150	490	980	700
	L-G	150	570	980	700
	N-G	150	640	1170	700
	L-L	300	500	1600	1200
277/480	L-N	320	450	1420	1200
	L-G	320	540	1540	1200
	N-G	320	570	1600	1000
	L-L	552	530	2600	2000

E. Electrical Noise Filter- each unit shall include a high performance EMI/RFI noise rejection filter with a maximum attenuation of 54dB per MIL-STD-220B.

1. SPD shall include an EMI/RFI noise rejection filter for all L-N modes as well as a removable filter in the N-G mode.

F. Integral Disconnect Switch (IF REQUIRED)

1. The device shall have an optional NEMA compliant safety interlocked integral disconnect switch with an externally mounted metal manual operator.
2. The switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption to the facility's distribution system.

3. The switch shall be rated for 600Vac.
4. The SPD device shall be tested to UL1449 4th Edition listed with the integral disconnect switch and the UL1449 VPR ratings shall be provided.
5. The integral disconnect switch shall be capable of withstanding, without failure, the published maximum surge current magnitude without failure or damage to the switch.
6. The line side of the integral disconnect shall be blocked off so that when the SPD is opened there is no direct access to the voltage present on the line side of the disconnect.

G. The UL1449 Voltage Protective Rating (VPR) shall be permanently affixed to the SPD unit.

H. The UL1449 Nominal Discharge Surge Current Rating shall be 20kA

I. The SCCR rating of the SPD shall be 200kAIC without the need for upstream over current protection.

J. The SPD shall be listed as Type1 SPD, suitable for use in Type1 or Type2 applications.

K. The SPD shall have the following monitoring options available.

1. Time Date stamp, duration and magnitude for the following power quality events (sags, swells, surges, dropouts, outages, THD, frequency, Volts RMS per phase)
2. SPD monitoring shall track surge protection and display it as a percentage
3. SPD shall provide a surge counter with three categories to be defined as Low Level surge (100A-500A) Medium Level surge (500A-3,000A) High Level surge (>3,000A)

PART 3 - EXECUTION/INSTALLATION

3.1 STARTUP - The SPD manufacturer's technician shall perform a system checkout and start-up in the field to assure proper installation, operation and to initiate the warranty of the system. The technician will be required to do the following:

A. Verify voltage clamping levels utilizing a diagnostic test kit, comparing factory readings to installed readings.

B. Verify N-G connection.

C. Record information to a product signature card for each product installed.

3.2 Unit may be installed on either the line or load side of the main service disconnect. If installed on the line side unit shall be installed with an integral disconnect. If installed on the load side the unit shall be installed on the largest breaker size available. If installed lead length exceeds 5' installer shall use a low impedance (HPI) cable to reduce the lead lengths effect on the installed performance of the SPD.

PART 4 - PRODUCT WARRANTY

4.1 Warranty on defective material and workmanship shall be for 15 years.

4.2 Copy of Warranty to be sent with submittal.

END OF SECTION 26 43 13

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 REFERENCES

A. ANSI/NFPA 70, National Electrical Code

B. IEEE C62.41, Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits

C. FCC 47 CFR Part 15, Federal Code Of Regulation (CFR) testing standard for electronic equipment

D. IESNA LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products

E. IESNA LM-80, Approved Method for Measuring Lumen Maintenance of LED Light Sources

F. UL1598, Standard for Safety of Luminaires

G. NEMA SSL 3-2010, High-Power White LED Binning for General Illumination

1.3 SUMMARY

A. This Section includes interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, lamps, drivers, emergency lighting units, and accessories.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:

1. Dimensions of fixtures.
2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
4. Emergency lighting unit battery and charger.

B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.

1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.

C. Submit product data on luminaires. Product data to include, but not limited to materials, finishes, approvals, photometric performance, and dimensional information.

D. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in the front end documents.

1.5 DRAWINGS

A. The drawings, which constitute a part of these specifications, indicate the general location of the luminaires. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

B. Photometric layout shall meet or exceed the criteria of the fixtures indicated on drawings.

1.6 QUALITY ASSURANCE

A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NFPA 70- Latest edition or edition enforced by state and local code authority.

C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

D. LED Luminaires

1. Manufactures of LED luminaires shall demonstrate a suitable testing program incorporating high heat, high humidity and thermal shock test regimens to ensure system reliability and to substantiate lifetime claims.
2. The use of IESNA LM-80 data to predict luminaire lifetime is not acceptable.
3. At time of manufacture, electrical and light technical properties shall be recorded for each luminaire. At a minimum, this should include lumen output, CCT, and CRI. Each luminaire shall utilize a unique serial numbering scheme. Technical properties must be made available for a minimum of 5 years after the date of manufacture.
4. Luminaires shall be provided with a 5 year warranty covering, LEDs, drivers, paint and mechanical component.

1.7 COORDINATION

A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.8 WARRANTY

A. General Warranty: The contractor shall warranty all work for one year after acceptance of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Fixture schedule on the drawings. Manufacture shall submit for prior approval where required at least (10) days prior to bid.

B. Subject to compliance with these specifications, luminaires shall be as manufactured by manufacture indicated on the drawings or prior approved equivalent.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs, sharp corners, and edges.

B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

2.3 EXIT SIGNS

A. Internally Lighted Signs: As follows:

1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.

2.4 LED LUMINAIRES

A. General: Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules.

B. Material and specifications for each luminaire are as follows:
1. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply)
2. Each luminaire shall be rated for a minimum operational life of 50,000 hours and to LM-70 lumen depreciation standards. This life rating must be conducted 40C ambient temperature.
3. The rated operating temperature range shall be -30°C to +40°C.
4. Each luminaire is capable of operating above 100°F [37°C], but not expected to comply with photometric requirements at elevated temperatures.
5. Photometry must be compliant with IESNA LM-79 and shall be conducted at 25°C ambient temperature.
6. The individual LEDs shall be constructed such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
7. Luminare shall be constructed such that LED modules may be replaced or repaired without replacement of whole luminaire.

8. Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires, or an equivalent standard from a nationally recognized testing laboratory.

C. Technical Requirements

1. Electrical
   a. Power Consumption: Maximum power consumption allowed for the luminaire shall be determined by application. The luminaire shall not consume power in the off state.
   b. Operation Voltage: The luminaire shall operate from a 60 HZ ±3 HZ AC line over a voltage ranging from 108 VAC to 305 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
   c. Power Factor: The luminaire shall have a power factor of 0.90 or greater.
   d. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent.
   e. Each Luminaire shall have UL Listed Class II power supplies. Class I power supplies will not be acceptable.
   f. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.
   g. RF Interference: LED Drivers must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
   h. Drivers shall have a Class A sound rating

2. Thermal Management
   a. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
   b. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.
   c. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
   d. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.
   e. The heat sink material shall be aluminum

2.5 FIXTURE SUPPORT COMPONENTS

A. Comply with "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Rod Hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.

C. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

D. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.6 FINISHES

A. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.

2. Metallic Finish: Corrosion resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.

B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
2. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

C. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3.2 CONNECTIONS

A. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Provide instruments to make and record test results.

C. Tests: As follows:

1. Verify normal operation of each fixture after installation.
2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
3. Verify normal transfer to emergency source and retransfer to normal.
4. Report results in writing.

D. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

E. Corrosive Fixtures: Replace during warranty period.

3.4 CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

END OF SECTION 26 51 00

SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes exterior lighting units with luminaires, lamps, drivers, poles/support structures, and accessories.

1.3 DEFINITIONS

A. Lighting Unit: A luminaire or an assembly of luminaires complete with a common support, including pole, post, or other structure, and mounting and support accessories.

B. Luminaire (Light Fixture): A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

1.4 SUBMITTALS

A. Product Data: For each type of lighting unit indicated, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Materials and dimensions of luminaires and poles.
2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
4. High-intensity-discharge luminaire ballasts.
5. LED and Driver information.

B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.

C. Maintenance Data: For lighting units to include in maintenance manuals specified in specifications.

1.5 QUALITY ASSURANCE

A. Luminaires and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use, location, and installation conditions by a testing agency acceptable to authorities having jurisdiction

B. Comply with NFPA 70- Latest edition or edition enforced by state and local code authority.

1.6 DELIVERY, STORAGE, AND HANDLING OF POLES

A. Store poles on decay-resistant treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

B. Retain factory-applied pole wrappings on metal poles until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.7 WARRANTY

A. General Warranty: The contractor shall warranty all work for one year after acceptance of the project for (5) years after acceptance of the project for LED.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Fixture schedule on the drawings. Products indicated in the fixture schedule shall meet the requirements of this specification. Manufacture shall submit for prior approval where required at least (10) days prior to bid.

2.2 LUMINAIRE SUPPORT COMPONENTS

A. Wind-Load Strength of Total Support Assembly: Adequate to carry support assembly plus luminaires at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 110 mph (160 km/h) with a gust factor of 1.3. Support assembly includes pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.

B. Finish: Match finish of pole/support structure for arm, bracket, and Tenon mount materials.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Will not cause galvanic action at contact points.
2. Mountings: Correctly position luminaire to provide indicated light distribution.
3. Anchor Bolts, Nuts, and Washers: Hot-dip galvanized after fabrication unless stainless-steel items are indicated.
4. Anchor-Bolt Template: Plywood or steel.

D. Pole/Support Structure Bases: Anchor type with hold-down or anchor bolts, leveling nuts, and bolt covers.

E. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

F. Concrete for Pole Foundations: Comply with "Cast-in-Place Concrete."

1. Design Strength: 3000-psig (20.7-MPa), 28-day compressive strength.

2.3 LED LUMINAIRES

A. General: Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules. The luminaires need to meet the requirements below.

B. Material and specifications for each luminaire are as follows:

1. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).

2. Each luminaire shall be rated for a minimum operational life of 50,000 hours at an average operating time of 11.5 hours per night. This life rating must be conducted 40C ambient temperature.

3. The rated operating temperature range shall be -30°C to +40°C.

4. Each luminaire is capable of operating above 100°F [37°C], but not expected to comply with photometric requirements at elevated temperatures.

5. Photometry must be compliant with IESNA LM-79 and shall be conducted at 25°C ambient temperature.

6. The individual LEDs shall be constructed such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.

7. Luminare shall be constructed such that LED modules may be replaced or repaired without replacement of whole luminaire.

8. Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires, or an equivalent standard from a nationally recognized testing laboratory.

C. Technical Requirements

1. Electrical

a. Power Consumption: Maximum power consumption allowed for the luminaire shall be determined by application. The luminaire shall not consume power in the off state.

b. Operation Voltage: The luminaire shall operate from a 60 HZ ±3 HZ AC line over a voltage ranging from 108 VAC to 305 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.

c. Power Factor: The luminaire shall have a power factor of 0.90 or greater.

d. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent.

e. Surge Suppression: The luminaire on-board circuitry shall include fused surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD shall protect the luminaire from damage and failure for common mode transient peak voltages up to 10 kV (minimum) and transient peak currents up to 5 kA (minimum). SPD shall conform to UL 1449 depending of the components used in the design. SPD

performance shall be tested per the procedures in ANSI/IEEE C62.41-1992 (or current edition) for category C (standard). The SPD shall fail in such a way as the Luminaire will no longer operate. The SPD shall be field replaceable.

f. Each Luminaire shall have integral UL Listed Class II power supplies. Class I power supplies will not be acceptable.

g. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.

h. RF Interference: LED Drivers must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.

i. Drivers shall have a Class A sound rating.

2. Photometric Requirements

a. Optical Assemblies: LEDs shall be provided with discreet over optical elements to provide IESNA Type II, III, IV or V distributions. Additional distributions for spill light control shall be utilized when light trespass must be mitigated. Mitigation must take place without external shielding elements. Optical assemblies shall have a minimum efficiency of 85% regardless of distribution type. For Type II and Type III distributions street side efficiencies shall be a minimum of 80%. All LEDs and optical assemblies shall be mounted parallel to the ground. All LEDs shall provide the same optical pattern such that catastrophic failures of individual LEDs will not constitute a loss in the distribution pattern.

b. Illuminance: The illuminance shall not decrease by more than 30% over the expected operating life. The measurements shall be calibrated to standard photopic calibrations.

c. Light Color/Quality: The luminaire shall have a correlated color temperature (CCT) range of 4,000K to 4,500K. The color rendition index (CRI) shall be 70 or greater. Binning of LEDs shall conform to ANSI/ G. NEMA SSL 3-2010.

d. Backlight-Uplight-Glare: The luminaire shall not allow more than 10 percent of the rated lumens to project above 80 degrees from vertical. The luminaire shall not allow more than 2.5 percent of the rated lumens to project above 90 degrees from vertical. Backlight and Glare ratings as per fixture schedule and calculated per IESNA TM-15.

3. Thermal Management

a. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.

b. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.

c. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.

d. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.

e. The heat sink material shall be aluminum.

4. Physical and Mechanical Requirements

a. The luminaire shall be a single, self-contained device, not requiring on-site assembly for installation. The power supply for the luminaire shall be integral to the unit.

b. The assembly and manufacturing process for the LED luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.

c. Luminaires shall be capable of withstanding cyclical loading in (G = Acceleration of Gravity): a minimum peak acceleration level of 3.0 G peak-to-peak sinusoidal loading with the internal driver installed, for a minimum of 100,000 cycles without failure of any luminaire parts. Testing to be performed in three planes: a horizontal plane parallel to the direction of mounting, a horizontal plane perpendicular to the direction of mounting and the vertical plane.

d. The housing shall be designed to prevent the buildup of water on the top of the housing. Exposed heat sink fins shall be oriented so that water can freely run off the luminaire, and carry dust and other accumulated debris away from the unit.

e. The optical assembly of the luminaire shall be protected against dust and moisture intrusion per the requirements of IP-66 (minimum) to protect all optical components

.

f. The electronics/power supply enclosure shall meet the requirements for NEMA/UL wet location.

g. Each mounted luminaire may be furnished with or without a photoelectric unit receptacle as per fixture schedule.

h. Door shall be hinged and secured to the housing in a manner to prevent its accidental opening.

i. The circuit board and power supply shall be contained inside the luminaire. Electrolytic capacitors used in the power supplies shall be rated for -40°F to 220°F (-40°C to +105°C), long life (> 5000 hours), and operated at no more than 70% of their rated voltage, and 70% of rated current.

5. Materials

a. Housings shall be fabricated from materials that are designed to withstand a 3000-hour salt spray test as specified in ASTM Designation: B117.

b. Each refractor or lens shall be made from UV inhibited high impact plastic such as acrylic and be resistant to scratching.

c. Polymeric materials (if used) of enclosures containing either the power supply or electronic components of the luminaire shall be made of UL94VO flame retardant materials. The len(s) of the luminaire are excluded from this requirement.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Concrete Foundations: Construct according to Section "Cast-in-Place Concrete."

1. Comply with details for reinforcement and for anchor bolts, nuts, and washers. Verify anchor-bolt templates by comparing with actual pole bases furnished.

2. Finish for Parts Exposed to View: Trowel and rub smooth. Comply with Section "Cast-in-Place Concrete" for exposed finish.

B. Install poles as follows:

1. Use web fabric slings (not chain or cable) to raise and set poles.
2. Mount pole to foundation with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
3. Secure poles level, plumb, and square.
4. Grout void between pole base and foundation. Use nonshrinking or expanding concrete grout firmly packed in entire void space.
5. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

C. Lamp luminaires with indicated lamps according to manufacturer's written instructions. Replace malfunctioning lamps.

3.2 CONNECTIONS

A. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

B. Ground metal poles/support structures according to Section "Grounding."

3.3 FIELD QUALITY CONTROL

A. Inspect each installed unit for damage. Replace damaged units.

B. Advance Notice: Give dates and times for field tests.

C. Provide instruments to make and record test results.

D. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

3.4 CLEANING AND ADJUSTING

A. Clean units after installation. Use methods and materials recommended by manufacturer.

B. Contractor to aim any adjustable luminaries per architect, engineer or owner’s requirements. Contractor to provide aiming at night and provide all necessary equipment needed to aim luminaires.

END OF SECTION 26 56 00

SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings.

1.2 RELATED SECTIONS

A. Applicable Division 27 and 28 sections.

1.3 SUMMARY

A. Work Included:

1. Communications equipment power system grounding.
2. Communications system grounding.
3. Communications equipment and raceway grounding and bonding.
4. Equipment grounding.
5. Conductor shield grounding.

B. Related work specified elsewhere. Refer to individual Division 26, 27 and 28 sections for specific grounding requirements in addition to those included in this specification.

1.4 CODES, STANDARDS AND REFERENCES

A. NFPA-70: National Electric Code (NEC)

B. NEC Article 250

C. NEC Article 800

D. ANSI J-STD-607A

E. UL Compliance: Applicable requirements of UL Standards Nos. 467 “Electrical Grounding and Bonding Equipment,” and 869, “Electrical Service Equipment,” pertaining to grounding and bonding of systems, circuits and equipment. In addition, compliance with UL Std. 486A, “Wire Connectors.” Grounding and bonding products are to be UL listed and labeled for their intended usage.

F. IEEE Compliance: Applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.

G. Comply with requirements in Section 26 05 26 - Grounding and Bonding for Electrical Systems for additional grounding requirements.

1.5 PROJECT COORDINATION

A. Coordination with other Divisions.

B. Refer to Basic Telecommunications Requirements.

1.6 SUBMITTALS

A. Procedures

1. Submit product data under provisions of Division 1.
2. Refer to Section 27 05 00 - Basic Telecommunications Requirements for specific submittal requirements.

B. Submittals General:

1. Provide grounding product data cut sheets.
2. Provide grounding product samples as requested.
3. Provide one line diagram of grounding system including all points of connection and routing of grounding or conductors.

C. Record Drawings

1. Provide as-built drawings of the installed grounding system
2. Refer to requirements in 27 05 00 - Basic Telecommunications Requirements.

1.7 QUALITY ASSURANCE

A. Manufacturer: Each manufacturer shall have been in the business of manufacturing the specified system(s) equipment and software for at least five years.

B. Contractor experience: Contractor shall have at least five years' experience in installing grounding systems for electronic systems and equipment of the type used for projects of similar size and complexity; and shall provide documentation id requested on three successful projects completed over the past five years of similar size and complexity.

1.8 WARRANTY

A. Refer to 27 05 00 - Basic Telecommunication Requirements for specific Warranty Requirements.

1.9 RELATED WORKS COORDINATION

A. Coordinate with Division 26 Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

A. Bonding equipment, including exothermic or removable screw type.

B. Ground Bus Bars:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Each Telecommunications Room (TR) depicted in the drawings shall be provisioned with a Telecommunications Grounding Busbar (TGB) meeting or exceeding the following requirements:

a. Each bar shall be installed with isolated standoff mounts.

b. Minimal bar size is ¼" thick x 2" wide x 10" long.
c. The TGB's shall be electroplated and pre-drilled for connector attachment to 6 AWG ground cables.
d. Holes spaced 1-1/8 inches (28 mm) apart.

3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Ground conductor shall be provided, installed and utilized for equipment, termination, cable tray, equipment rack and computer equipment grounding, conduits, racks and other equipment including telephone systems.

D. All grounding material and work shall comply with the National Electric Code (NEC Chapter 8), Local and State regulations as well as ANSI-J-STD-607-A.

E. Coordinate with the electrical power trades for grounding wiring interface to an approved connection to the building electrical power service panel ground source. Provide #6 AWG stranded copper bonding conductor extending from the electrical ground source to the Telecommunication Main Grounding Busbar (TMGB) located in the Telecommunications or equipment room.

F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Design Selection: B-Line #SB-477-K or equal.

G. Telecommunications Bonding Backbone (TBB) Conductors:

1. The TBB shall be installed to connect the TMGB to each TGB located in Telecommunications or equipment rooms. Separate TBB conductors shall run from the TMGB to each Telecommunications or equipment rooms on other building levels. TBB can be extended to TGB in Telecommunications or equipment rooms on the same level.
2. TBB Conductors shall be installed in ½" EMT.
3. TBB conductors shall green and sized according to distance as follows:

a. #6 AWG for distances less than 13'
b. #4 AWG for distances less than 13' to 20'
c. #3 AWG for distances less than 20' to 26'
d. #2 AWG for distances less than 26' to 33'
e. #1 AWG for distances less than 33' to 44'
f. #1/0 AWG for distances less than 44' to 52'
g. #2/0 AWG for distances less than 52' to 66'
h. #3/0 AWG for distances greater than 66'

4. #6 AWG stranded TBB with green jacket shall be installed between the TGB in each telecommunications or equipment room and each:

a. Enclosed equipment cabinet
b. Tray and ladder rack systems

PART 3 - EXECUTION

3.1 General

A. Provide a separate, insulated, equipment grounding conductor in all branch circuit conduits.

B. Use minimum No. 6 AWG copper conductor for communications service grounding conductor. Leave 10 feet slack conductor at terminal board or cabinet.

C. Provide isolated and insulated ground conductors for all microprocessor and data processing equipment. The isolated Equipment Ground Conductor (EGG) and neutral conductor for a given branch circuit shall not be shared across branch circuits.

D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torque requirements are not indicated, connections are to be tightened to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.

E. Provide code-sized ground cable bonding jumpers, installed with ground clamps, across all conduit expansion couplings and fittings, including flexible steel conduit used as expansion fittings.

F. Provide a corrosion-resistant finish to field connections where factory applied protective coatings have been destroyed.

G. All continuous runs of cable tray and all isolated sections of cable tray shall be bonded and grounded.

H. Provide an equipment grounding conductor in all nonmetallic conduits.

I. All receptacles and switches shall be provided with ground jumper from outlet box to ground terminal of the device. Exception isolated ground receptacles.

J. Provide parallel equipment bonding jumper for parallel conduit feeders.

K. Provide bonding jumpers around all concentric or eccentric knockouts.

L. The tops of ground rods driven outdoors shall be 6-inches below final grade. Prior to bonding rods, measure and record the earth resistance to each rod and document.

END OF SECTION 27 05 26

SECTION 27 13 00 - VOICE AND DATA SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This section includes the following: Inside station cables, multi-pair inside telephone cables, fiber optic cable, backboards, racks, inner duct, cross connects and outlets for voice and data use to each station outlet location as shown on the Drawings.

1. Conduits for communication service provider on site as shown on the Drawings or as indicated in specifications.

2. Backboards, relay rack, mounting brackets and associated hardware for bundling, racking and cross-connecting data cables as shown on the Drawings or as indicated in specifications. Provide 20 percent future capacity on all patch panels.

3. Category 6, four-pair communications cable (for voice) and Category 6 (Cat 6), four-pair communications cable (for data) to each voice/data outlet location as indicated on Drawings. Furnish a four (4) position face plate at each location.

4. 4 position, 8 conductor (4 pair) modular voice/data jacks at each telephone/data outlet shown on Drawings and as specified herein.

5. Relay racks with patch panels, and wire management frame for terminating data and voice station cables.

6. Duplex receptacles and ground bus, and connection of ground bus to building system.

1.2 QUALITY ASSURANCE:

A. All work and equipment shall conform to the applicable portions of the following specifications, codes and regulations:

1. Building Industry Consulting Services International (BICSI)

2. Telecommunications Distribution Methods Manual

3. BOCS and AT&T Plant Standards

4. ANSI/EIA/TIA Standards

5. National Electrical Code (NEC)

6. State Codes

B. Maintenance Considerations:

1. The cable and wire system shall be installed to maximize the safety, maintainability, and performance effectiveness of maintenance personnel and minimize the demands upon skills, training, and manpower. Splices/terminations shall be placed and supported with convenient accessibility so as to maximize the efficiency and ease with which it can be maintained. No cables shall be spliced unless as shown on plans or approved by Engineer.

C. Cable and wire identification, testing, and documentation shall be specified in Part 3.00 herein.

1.3 SHOP DRAWINGS:

A. Shop drawings shall be submitted for review and shall include complete catalog and other information shown to describe the cables, wire, and equipment proposed to be furnished and numbered locations for all data and voice locations.

PART 2 - PRODUCTS

2.1 VOICE/DATA STATION CABLE:

A. Industry standard Category 6 communications wire and cable shall be used for all telephone applications. Station Cable shall be four-pair, unshielded, twisted pair, Category 6 or Category 6A, Inside-station cable, and shall be constructed of solid 23 gauge annealed copper. Cable shall have Category 6 or 6A transmission characteristics as specified by ANSI/EIA/TIA-568B. Each conductor shall be insulated with a continuous layer of fluorinated ethylene propylene (FEP). The sheath shall be all weather, flame resistant. Station wire shall be constructed of 4 twisted pair sharing one sheath. General Cable GenSpeed 6500, Hubbell NEXTSPEED or prior approved equal.

B. Voice/Data station wiring shall be Category 6 (Cat 6) communications wire and cable and Category 6A (Cat 6A) for wireless access point device cable. Station Cable shall be four-pair, unshielded, twisted pair, inside-station cable, and shall be constructed of solid 23 gauge annealed copper. Each conductor shall be insulated with a continuous layer of fluorinated ethylene propylene (FEP). The sheath shall be all weather, flame resistant, polyvinyl chloride. Station wire shall be constructed of 4 twisted pair sharing one sheath. Voice/Data cable shall be terminated in a 110 rack mounted patch panel. The use of 66 or 110 patch panels is not allowed for station. Cable shall have Category 6 transmission characteristics as specified by ANSI/EIA/TIA-568B and meet the following performance characteristics. General Cable GenSpeed 6500 (Cat6) and GenSpeed 10,000 (Cat6A), Hubbell NEXTSPEED or prior approved equal.

C. Cables routed in air plenum shall have a sheath and conductor insulation constructed of material so as to be classified as type CMP as defined by the NEC 800-3(b)(3).

D. Cable jacket color shall be as follows:

White	Voice
Blue	Data
Yellow	Wireless Access Points (6A)
Surveillance Cameras	Purple

Final color shall be approved by the engineer in shop drawings. Engineer has the right to change color of the cables.

2.2 CROSS-CONNECT WIRE:

A. Cross-connect wire shall be furnished and installed by Contractor. Contractor shall provide enough patch cables for all possible connections. Cross-connect must be factory certified Category 6 for voice connections and compatible with Category 6 or 6A for data wiring.

2.3 COMMUNICATIONS OUTLET:

A. Telephone and data outlets shall be a combination voice/data communication unit. Wall mounted outlets shall be flush mounted in a double gang utility box and covered with voice and data device plates. Raceway mounted outlets shall be flush mounted and covered with voice and data device plates. Complete outlet shall consist of utility box, communication assembly devices, cover plate, and jack inserts. All voice/data outlet inserts shall be eight (8) position/eight (8) conductor, insulation displacement, Hubbell part number HXJ6xx only, EIA/TIA 568B Category 6 compliant or equivalent for 6A.

B. Communications outlets shall be furnished by one manufacturer. Outlet shall be furnished with 4-position, Category 6 or 6A compliant, RJ-45 modular jacks. Each outlet shall consist of voice jacks and data jacks in the locations as shown on Drawings. Voice only outlets shall consist of one (1) voice jack. Data jacks shall be compatible with Category 6 or 6A wiring depending on the application.

C. Outlets shall consist of the following items:

1. Face Plate.
2. Data Jack Inserts.
3. Voice Jack Inserts.
4. Blank Inserts.
5. Outlets shall have circuit identification holders and labels.

D. The device plate colors shall be as selected by architect per space.

2.4 CONNECTING BLOCKS:

A. Voice feeder and station cables shall be terminated on Category 6 or 6A compliant, type 110 patch panels depending on the application. All panels shall be 48-port type.

B. The patch panels shall support 100 MHz cross connect transmission for UTP cabling systems utilizing Category 6 or 6A performance rated cable. Terminations shall use 110-IDC (Insulating Displacement Connector) field made continuous to the 8-pin modular jack on front of panel via Printed Circuit interconnections. The panel shall mount on nineteen (19") inch rack and be fully EIA/TIAT568B compliant. Panels will be T568B wiring.

2.5 RELAY RACK:

A. Relay rack shall be open frame design, tubular metal, 19" wide x 84" high for 19" rack mounting equipment. Panel mounting holes are to be #12-24 tapped on EIA universal spacing on both front and rear of rack. Rack to be self supporting with base suitable to floor mount. Rack shall be suitable for front and rear mounting of patch panels and/or Owner furnished concentrator hubs. Rack shall be furnished with 3.5" high wire management frames and supports as shown on the Drawings, or as required for installation. Rack will be furnished with a horizontal manager for each patch panel, 2 vertical managers and a Chatsworth cable run kit.

B. Relay rack to be Bud Industries ARR-1272, Homaco 19-84-T2S, ICCMSR1984 or approved equal. Wire management support shall be two-position organizer panel.

2.6 CABLE MANAGEMENT:

A. Cable management or cable organizers shall be metal panels equipped with distributing rings and are to be used to provide vertical and horizontal paths between terminal blocks

for routing cables. Cable management or cable organizers shall be a combination style to handle front, rear, vertical and horizontal cable/patch cords pathways in a standard nineteen (19") inch rack space. The oversized front rings meet larger-capacity requirements for Category 6 patch cords and rear management reduces tension stress/bending radius of cables routed from inside or outside of vertical channels. The panel will have metal legs to allow cables to pas behind the panel. A white, fire-retardant polycarbonate plastic frame 110-type jumper trough shall be provided. Trough shall be designed to accommodate patch cords and outlet cables. Troughs shall be installed between each 100 pair wiring block and at the top and bottom of each column for routing purposes. Cable organizers shall be Leviton 49252-PCM, Homaco HFM-19-2 or approved equal.

2.7 CORRUGATED FLEXIBLE CONDUIT:

A. Corrugated flexible conduit, or INNER DUCT, shall be a non-metallic, flexible conduit intended for power and communications applications. Duct shall be suitable for underground installations, and suitable for installation inside larger power or communications conduits.

B. The corrugated duct shall be sized as shown on the Drawings. Duct shall be orange in color and shall be furnished on 250' reels or in 250' coils. Duct manufacturer shall furnish required PVC fittings.

C. All vertical fiber optic riser cables shall be installed in riser rated inner duct. The inner duct shall extend to the relay rack as near as practical to the fiber termination shelf.

2.8 PATCH PANELS:

A. The patch panels shall support 100 MHz cross connect transmission for UTP cabling systems utilizing Category 6 or 6A performance rated cable. Terminations shall use 110-IDC (Insulating Displacement Connector) field made continuous to the 8-pin modular jack on front of panel via Printed Circuit interconnections. The panel shall mount on nineteen (19") inch rack and be fully EIA/TIAT568B compliant. Panels will be T568B wiring.

2.9 OUTDOOR IN-GRADE BOXES

A. Furnish and install lightweight pre-fabricated pull box where shown on the Drawings. Power service box shall be nominal 24" x 36" size with cover for light traffic duty. Box shall be stack able to obtain required depth. Cover shall be marked with TELEPHONE logo. A bottom is required on box.

B. Pull box shall be pre-cast concrete construction or pre-cast heavy weave fiberglass and polymer concrete. Pull box shall be equal to Quazite Composite “PC” Style, or Associated Plastics PH3660/36 VAULT Series.

2.10 VIDEO CABLING

A. The contractor shall provide RG6 coaxial cabling from the video jack locations where indicated by the TV symbols on the drawings denoted with “C” (coax). The RG6 shall be plenum rated and shall be homerun to the nearest communications room.

B. Provide an “F” connector at every jack.

C. Cable shall be plenum in plenum rated ceilings.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Unless otherwise specified, all communications systems shall be permanently installed

and connected to the wiring systems. The systems must be installed according to manufacturer standards and recommendations.

3.2 TELEPHONE/DATA SYSTEM GENERAL REQUIREMENTS:

A. All cables, wires, and equipment shall be securely and neatly installed. Inside routing shall be installed parallel and perpendicular to existing structural lines and members.

B. Each station wire shall be plainly marked at its patch panel end with the room number to which it is connected, and terminated on the termination blocks or patch panel.

C. Voice/data cables shall be routed above ceilings utilizing cable hooks. Cables must not be secured to hooks. Provide hooks a minimum of four feet on center.

D. Contractor shall maintain recommended Category 6 bending radius, pulling tension, and cable support requirements. Cable ties may be finger tight, however, not so tight so they distort the outer jacket of the cable.

E. Cable suspended above an open ceiling shall not rest on ceiling tiles or lighting fixtures, and shall be supported from roof structure at 4' intervals.

F. Voice/data system wiring shall be installed in accordance with NEC Article 800-5 and 6 requirements.

3.3 TELEPHONE/DATA CABLE INSTALLATION:

A. Station cable installation shall consist of the following:

1. All conduits stubbed up in ceiling spaces shall have conduit bushing at end of conduit.
2. From the outlet location to the telephone backboard, Contractor shall furnish and install voice and data cables as per Drawings. Voice only stations shall have one (1), four (4) pair station cable.
3. Each cable shall also be labeled per face plate detail.
4. Voice jack shall be installed in top left position at each location.
5. At modular furniture locations contractor shall provide outlets and cable indicated on the drawings. Cable shall be installed and terminated in the modular furniture complete from outlet to patch panel. Contractor to install cable in modular furniture raceway then to flexible conduit and to a junction box in adjacent wall. Refer to detail on drawings.
6. Provide 4’-0” of slack at each outlet location. Slack shall be in ceiling space.

3.4 COMMUNICATIONS SYSTEM QUALIFICATIONS:

A. The communications system installer shall be experienced in the design, fabrication and installation of communications premise distribution systems of similar size and scope to this project. Installation technicians shall be manufacturer certified in At & T Systimax Structured Cabling System, AMP Netconnect Cabling System, Siecor wiring systems, or equal.

3.5 CABLE/WIRE IDENTIFICATION:

A. The following labeling procedure shall be completed by the Contractor after each cable has been installed and connected:

1. Each cable pair shall be plainly marked at the patch panel end.
2. All outlets shall be permanently marked or labeled on the jack faceplate ID number.
3. All cables shall be legibly and permanently labeled at each end using wrap-around/stick-on label systems or approved equal.

4. In rooms where more than one jack exists, the jacks shall be labeled per the faceplate detail.

5. All conduits, except those used for individual station jacks, shall be clearly and permanently marked or labeled at both ends, indicating the location of the other end of the conduit.

B. All cable and wiring identification shall be in compliance with ANSI/TIA/EIA 606 Structured Cabling System standards. No hand-written labels will be accepted on face place and patch panels.

3.6 DOCUMENTATION AND TESTING:

A. Upon completion of construction, the Contractor shall provide “as installed” drawings showing the exact placement of all outlets, cables, conduits and connecting hardware called for in this section.

B. Voice and data wiring shall be tested upon completion of installation. In order for any voice cable to be accepted, the number of defective pairs shall be limited to a maximum of one percent (1%) of the total number of pairs in the cable. Any cable having more than the maximum acceptable number of defective pairs shall be replaced at the Contractor’s expense. The cable test results shall be provided with the “as installed” drawings upon the completion of construction.

C. Voice and Data station cables shall contain no defective pairs.

D. Testing Procedures

1. Testing shall be performed in the presence of a representative as designated by the architect or engineer. Sufficient advanced notice of test dates shall be provided to coordinate test dates.

2. All voice (station, riser & outside plant) cables and associated connection hardware shall be tested and documented by the Contractor. The test procedure shall demonstrate as a minimum:

   a. Continuity (more than 2,600 ohms is considered an open)

   b. Shorts (60,000 ohms or less is considered a short)

   c. Proper polarity (tip and ring correct)Proper polarity (tip and ring correct)

   d. Proper termination (splits & wrong terminations)

   e. Proper ground and shield bonding

   f. Grounded conductors (60,000 ohms or less to ground is considered a fault)

   g. Detection of A/C or DC power on any conductor (power fault test)

   h. User’s equipment must function normally when connected to the installed wiring

3. All UTP data station and riser cables and associated connection hardware shall be tested to certify the performance category of the link as installed. All Category 6 station cables shall be tested in accordance with procedures laid out in EIA/TIA 568B.2-1. Written (printed) test results for each cable shall include all of the field test parameter results. Any cable that fails testing shall be reported along with the procedures used to rectify the failure (IE. Replaced cable, re-terminated the jack, etc.). Contractor tests shall utilize a category six (6) complaint cable tester. Fluke and HP are approved tester. Electronic results for each UTP Category 6 four pair cable shall be submitted as a part of the Contractors as built project performance acceptance records. In addition to the above information the

documentation shall include a pass/fail indication for the specified cable, the test date, the serial number and software version of the scanner used, and a copy of the calibration certificate of the scanner. Necessary applications for reading the results shall be provided by the Contractor. This document can be found in the EIA/TIA Telecommunications Building Wiring Standards.

4. The Contractor shall test, certify and document each fiber optic conductor to meet the following attenuation specifications:

   a. Power meter test: (cable length per 1000'times 1.22) + connector loss + splice loss= acceptable loss in dB@850 nm, nominal. End-to-end testing shall include all connectors and jumpers. The Contractor shall supply all required meters, jumpers and light sources for this test.

   b. OTDR Test shall be performed by the Contractor on each fiber strand and on each fiber segment installed at both 850 nm and 1300 nm for multimode cable. If single mode cable is installed OTDR tests shall be performed at both 1310 nm and 1510 nm. Two sets of hard copy printouts of the OTDR graphs for each fiber strand shall be presented to the A/E. Fiber termination made on site shall be of factory quality and tested for attenuation loss not to exceed 0.5 dB per mated connection at 1300 nm for multimode fiber and 1550 nm for single mode fiber. Fiber connector terminations shall be made by a factory trained technician with ample field experience. Fiber technician certification shall be submitted to the A/E with the fiber test documentation.

E. Prior to testing of any communications cable/wire and hardware, the Contractor shall notify The Architect in writing, at least two (2) weeks in advance of testing. Contractor shall furnish hard copy of all test reports to Architect for approval prior to completion and final acceptance of project.

F. Submit documentation regarding the manufacturer's extended warranty. The length of the extended warranty shall be a minimum of twenty (20) years. The documentation shall include a sample of the warranty that shall be provided to the Owner when the installation is complete, as well as procedures for handling warranty issues. The warranty shall be for the complete system.

END OF SECTION 27 13 00

SECTION 27 51 23 - INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Microprocessor-switched intercommunications and program systems with the following components:
   1. Intercommunication amplifier.
   2. Paging amplifier.
   3. Loudspeakers/speaker microphones.
   4. Conductors and cables.
   5. Raceways.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For intercommunications and program systems. Include plans, elevations, sections, details, and attachments to other work.

   1. Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include scaled drawings for master station that detail built-in equipment.
   3. Wiring Diagrams: For power, signal, and control wiring.

      a. Identify terminals to facilitate installation, operation, and maintenance.
      b. Single-line diagram showing interconnection of components.
      c. Cabling diagram showing cable routing.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated with each other, using input from Installers of the items involved.

D. Qualification Data: For qualified Installer and testing agency.

E. Field quality-control reports.

F. Operation and Maintenance Data: For intercommunications and program systems to include in operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

   1. A record of Owner's equipment-programming option decisions.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of ceiling-mounted speaker microphones with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Bogen Communications, Inc.
   2. Dukane Communication Systems; part of GE Infrastructure, Security.
   3. TOA Electronics, Inc.

2.2 FUNCTIONAL DESCRIPTION OF MICROPROCESSOR-SWITCHED SYSTEMS

A. Zone Paging System:
   1. Provide a Bogen PCM 2000 or equivalent paging amplifier and zone controller.

B. Speakers: Free of noise and distortion during operation and when in standby mode.

2.3 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.

C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

D. Weather-Resistant Equipment: Listed and labeled by an NRTL for duty outdoors or in damp locations.

2.4 PAGING AMPLIFIER

A. Input Voltage: 120-V ac, 60 Hz.

B. Frequency Response: Within plus or minus 3 dB from 60 to 10,000 Hz.

C. Minimum Signal-to-Noise Ratio: 60 dB, at rated output.

D. Total Harmonic Distortion: Less than 3 percent at rated power output from 70 to 12,000 Hz.

E. Output Regulation: Less than 2 dB from full to no load.

F. Controls: On-off, input levels, and low-cut filter.

G. Input Sensitivity: Matched to input circuit and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on speaker microphones or handset transmitters.

H. Amplifier Protection: Prevents damage from shorted or open output.

I. Output Circuit: 70-V line.

2.5 CONE-TYPE LOUDSPEAKERS/SPEAKER MICROPHONES

A. Minimum Axial Sensitivity: 91 dB at one meter, with 1-W input.

B. Frequency Response: Within plus or minus 3 dB from 70 to 15,000 Hz.

C. Minimum Dispersion Angle: 100 degrees.

D. Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.

E. Enclosures: Steel housings or back boxes, acoustically dampened, with front face of at least 0.0478-inch (1.2-mm) steel and whole assembly rust proofed and factory primed; complete with mounting assembly and suitable for surface ceiling, flush ceiling, pendant or wall mounting; with relief of back pressure.

F. Baffle: For flush speakers, minimum thickness of 0.032-inch (0.8-mm) aluminum with textured white finish. **Final color per architect per ceiling type.**

G. Size: 8 inches (200 mm) with 1-inch (25-mm) voice coil and minimum 5-oz. (140-g) ceramic magnet.

H. Verify speaker type according to final architectural reflected ceiling plans and speaker locations on drawings. Speakers in grid ceilings shall be 2x2 lay-in type, and ceilings in hard ceilings shall be round type suitable for gyp board ceiling mounting.

2.6 CONDUCTORS AND CABLES

A. Conductors: Jacketed, twisted pair and twisted multipair, untinned solid copper. Sizes as recommended by system manufacturer, but no smaller than No. 22 AWG.

B. Insulation: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.

C. Shielding: For speaker-microphone leads and elsewhere where recommended by manufacturer; No. 34 AWG, tinned, soft-copper strands formed into a braid or equivalent foil.

1. Minimum Shielding Coverage on Conductors: 60 percent.

D. Plenum Cable: Listed and labeled for plenum installation.

2.7 RACEWAYS

A. Intercommunication and Program System Raceways and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Intercommunication and Program System Raceways and Boxes: Same as required for electrical branch circuits specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

C. Intercommunication and Program System Raceways and Boxes: EMT.

D. Outlet boxes shall be not less than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

E. Flexible metal conduit is prohibited.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters, and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF RACEWAYS

A. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wire ways.

B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements:

1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
3. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
2. Suspend speaker cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceiling by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches (300 mm) apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

3.4 INSTALLATION

A. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

B. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.

C. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.

D. Speaker-Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.6 SYSTEM PROGRAMMING

A. Programming: Fully brief Owner on available programming options. Record Owner's decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and final results.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Schedule tests with at least seven days' advance notice of test performance.
2. After installing intercommunications and program systems and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: Test originating, all-call, and page messages at each intercommunication station. Verify proper routing and volume levels and that system is free of noise and distortion. Test each available message path from each station on system.
4. Frequency Response Test: Determine frequency response of two transmission paths by transmitting and recording audio tones. Minimum acceptable performance is within 3 dB from 150 to 2500 Hz.
5. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:

    a. Disconnect speaker microphone and replace it in the circuit with a signal generator using a 1000-Hz signal. Measure signal-to-noise ratio at paging speakers.
    b. Repeat test for four speaker microphones and for each separately controlled zone of paging loudspeakers.
    c. Minimum acceptable ratio is 35 dB.

6. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 150, 200, 400, 1000, and 2500 Hz into each paging and all-call

amplifier, and a minimum of two selected intercommunication amplifiers. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 5 percent total harmonics.

7. Power Output Test: Measure electrical power output of each paging amplifier at normal gain settings of 150, 1000, and 2500 Hz. Maximum variation in power output at these frequencies is plus or minus 3 dB.
8. Signal Ground Test: Measure and report ground resistance at system signal ground. Comply with testing requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

F. Intercommunications and program systems will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service and initial system programming.

1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
2. Complete installation and startup checks according to manufacturer's written instructions.

3.9 ADJUSTING

A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the intercommunications and program systems.

1. Train Owner's maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining the system and equipment.

END OF SECTION 27 51 23

SECTION 27 52 23 - NURSE CALL SYSTEMS

PART 1: ENGINEER'S SPECIFICATION

1.1 OVERVIEW

A. It is the intention to install a single, facility-wide, Nurse/Patient Communications Network that offers virtually unrestricted flexibility in assignment of annunciation for system patient stations, peripherals, and nurse consoles. This system shall be a single network capable of up to: 20 Tek-CARE® Module variations, supporting Master Station consoles, Patient Stations and Peripheral Stations. Conventional nurse call systems that utilize limited Personal Computer operating systems or local controller/switchers shall not be accepted. All system components shall be listed to the UL®1069 standard by a qualified NRTL. Systems having a "core" system only listed shall not be acceptable.

1.2 REFERENCES

A. Underwriter's Laboratories ANSI/UL®1069 (TekTone TC400 P5+)

B. Underwriter's Laboratories ANSI/UL®2560 (TekTone TC400 P5 and TC500)

C. Canadian Standards Association C22.2, No. 205

D. National Electrical Code, ANSI/NFPA 70

E. Health Care Facilities, ANSI/NFPA 99

F. U.S. Dept. of Labor / Occupational Safety and Health Administration

G. State Hospital Code / Joint Commission of Hospitals—Nurses Call Requirements

ISO 9001:2015 Quality Standard

1.3 QUALIFICATIONS

A. Authorized Distributor for product supplied for a minimum of two years. Authorized Distributor Letter from manufacturer required upon request of specifying authority.

B. Applicable state licenses.

C. A current certificate of successful completion of manufacturer's installation/training school for installing technicians of the equipment being proposed.

1. Training recertification to occur every 3 years

D. Authorized Distributor shall provide three nurse call references when submitting bid demonstrating the capability to perform the requirements stated in this project's specifications and project drawings.

1.4 SYSTEM DESCRIPTION

A. System hardware shall be manufactured by an ISO 9001:2015 certified company. Equipment manufactured by companies that are not ISO 9001:2015 shall not be acceptable. The wired nurse call system hardware shall consist of the CENet nurse/patient communications network, comprised of: NC455CE Master & Station Module, Master Station Consoles (two configurations): NC404TS Touchscreen (22") Master Station, or NC415AV Touchscreen (5") Master Station, as well as an Integration Server: NC475 Tek-CARE® Appliance Server. Patient stations, bath pull-cord stations, bed side-rail interfaces, code call stations, corridor dome lights, call cords, emergency pull-cord stations, emergency push button stations, lamp control modules, presence stations, radio page interface and wiring shall be supplied as shown on the drawings. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, shall be supplied and installed to provide a complete and operating nurse/patient communications network. The system shall provide for full-duplex audio between master stations in the handset mode, and remote (patient, staff and duty) audio stations. Half-duplex audio shall be selectable by individual remote audio station for areas with abnormal acoustical requirements. System firmware shall be the product of a reputable firmware manufacturer with a proven history of product reliability and sole control over all source code. System firmware upgrades shall not require any exchange of parts. Any supplier whose equipment requires the exchange of parts for firmware upgrades shall not be acceptable. Equipment manufacture and testing shall be executed by an ISO 9001:2015 certified company. Manufacturing testing

shall utilize applicable custom fixtures to assure the highest quality production. The Nurse Call System provider shall provide a Fail-Safe Network topology as described below:

1. The Network shall be of a closed, proprietary nature, except where routing technology is employed to provide limited, controlled access to external ancillary systems. The Network bandwidth shall be automatically monitored and the traffic shall be automatically controlled to ensure the specified performance.

2. The Central Equipment must be able to function as a Network using a bus topology. A single failure of one NC455CE Master & Station Module shall not affect the functioning of other NC455CEs.

3. The Network shall be electrically supervised and include verification protocols for all critical data transmissions.

4. All components on the Network shall be provided with battery backup power in the event of the loss of facility-supplied AC power.

5. All system data required for the Network's operation and that of its components as relates to the primary nurse call functions shall reside in non-volatile solid-state memory. In the event of catastrophic failure due to adverse environmental conditions, the system shall use the most recent data to recover to normal operation.

6. It shall be possible to remove patient data from the system configuration before making it portable for saving or troubleshooting and merge the information back once done.

1.5 SUBMITTALS

A. The system described by this specification is the Tek-CARE400 P5+ system using the NC455CE Master & Station Modules, manufactured by TekTone Sound and Signal Mfg., Inc. The Tek-CARE400 P5+ system using NC455CE modules meets all requirements outlined in this specification. The Tek-CARE400 P5+ system using NC455CE modules shall be considered the basis for all submitted bids.

B. Any supplying contractor proposing equipment which is not the base standard for this specification must provide full submittals at the time of bid. This option shall be exercised at the discretion of the owner/specifying authority. Prior to commencement of work, the supplying contractor shall submit complete electronic submittal sets consisting of the following:

Page 1: Name of supplying contractor and project name.

Page 2: In the following order, a listing of: component quantities, equipment manufacturer, model number, and description of each component being supplied. If equipment being supplied is not the specified equipment manufacturer's model, alongside the submitted model number and description, list the specification paragraph that corresponds to the equivalent specified model. Failure to provide this information shall result in the rejection of submittals.

Page 3: Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is an Authorized Distributor of the product being supplied.

Page 4: A statement of warranty policy from manufacturer.

Page 5: A copy of the installing technician(s) certificate of completion from the manufacturer's training school (within three years from submittal date) for the equipment being proposed.

Page 6: A written statement by contractor of how and when they will complete In-Service Training, including the minimum number of hours being provided per system, procedures they will follow, what training aids are provided (technical and user manuals, data sheets, etc.) and how contractor will conduct training.

Page 7: A written statement from contractor of: (a) exactly how the contractor will test installed equipment and wiring, and (b) exactly how all the tests recommended by manufacturer will be performed by the contractor, prior to commissioning of system.

Page 8: Provide a written copy of the manufacturer's list of all of the recommended spare parts to maintain all systems specified after the warranty period. Provide the purchase price and turnaround cost (i.e., Facility's) associated with each item. List separately the cost of an annual maintenance. Show the hourly, purchased labor rates for both regular and emergency service. State any additional charges that may accompany labor charges (such as, but not limited to, travel charges, lodging, etc.).

Pages 9+: One catalog sheet per product of equipment listed on page 2, in the exact order as listed on page 2. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. Photocopy duplications of the manufacturer's original equipment catalog sheets

will be allowed as long as they provide adequate clarity of all printed words, graphics, pictures, illustrations and other information material to the evaluation of the submittal. Submittals that are not of adequate clarity or content may be rejected and resubmission may not be allowed.

Last Page(s) or Separate: Provide all inter-equipment wiring diagrams and drawings necessary to install the equipment being supplied. These drawings will show, in detail, all wiring types by wire gauge, conductors and wire manufacturer. These drawings must be updated prior to completion of any work to reflect changes that may have been made during actual installation. In the event the specifying authority decides to reject the submittals of a supplying contractor, the specifying authority may ask the contractor to resubmit if the discrepancies are minor. Otherwise, rejection of submittals means the specified product must be supplied.

1.6 PROJECT SITE VISIT

A. It is the responsibility of all prospective contractors to make an adequate inspection of the project site or review of project plans. Any contractor not registered as having attended the mandatory site visit tour or the project plans review meeting will be disqualified and any bid proposal will automatically be rejected.

1.7 DEMONSTRATIONS

A. It may be necessary to utilize demonstration equipment to test the functional operation of the contractor's submitted equipment. Contractor will be notified of any demonstration dates and times. If such demonstrations are utilized, it will be the sole judgment of the owner and/or owner's designated specifying authority to decide whether a contractor/manufacturer meets or exceeds the specification. All demonstrated equipment must be of a standard single manufacturer and meet the same required testing and conditions that are applicable to the manufactured equipment. Custom or modified equipment that is not of standard, current manufacture cannot be demonstrated. If necessary, owner and/or specifying authority may visit the manufacturer's facility to view functioning equipment or demonstrations and witness equipment manufacturing techniques and/or testing procedures.

1.8 SAMPLES

A. The owner/specifying authority reserves the right to request one each, samples of terminal (station) equipment for the purpose of coordinating colors, aesthetics, trim-plate sizing, etc. These samples would be supplied at no cost to the owner after bid is awarded.

1.9 SCHEDULING

A. It is the responsibility of the general contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The owner will not be liable for any additional costs due to missed dates or poor coordination of the supplying contractor with other trades.

1.10 WARRANTY

A. The warranty shall include all necessary labor and equipment to maintain the system(s) in full operation for a period of one year from the date of acceptance. Equipment only, manufactured by the manufacturer shall be warrantied for five years; provided the installation is performed by factory-certified technicians, and an inspection of the installation is done by a person(s) designated by the factory. The contractor shall maintain a service department, necessary spare parts, telephone answering services, and call dispatching required to implement the service standard stated below as part of this contract. After the acceptance of the system(s), service shall be provided on the following basis:

Emergency Service—Provided **24 hours a day.** When a total or catastrophic failure of equipment is reported to contractor, within 2 hours of notification, a service person will be on site. (An example of a catastrophic failure would be a central equipment failure or a nurse master station failure.)

Routine Service—Provided **within 4 business hours** (9 a.m. to 5 p.m., Monday through Friday, excluding holidays) **of notification.** When a minor failure of equipment is reported to the contractor on a Saturday or Sunday, a service person will be on site within 4 hours of notification. (An example of a minor failure includes equipment such as patient stations, corridor lights, pull-cord stations, etc., which normally affect only one patient or patient room.)

1.11 MAINTENANCE

A. The contractor shall:

1. Provide necessary spare parts, noted on Page 8 of submittal (see Section 1.05), after commissioning of system(s) and before final payment.

2. Provide sponsorship for at least one person designated by the owner to attend a service school held by the equipment manufacturer. Transportation to this school, meals, and lodging will be borne by the owner. The equipment manufacturer shall provide school free of charge at TekTone.

3. The owner may choose to have the supplying contractor maintain the system(s). The level of service provided during the maintenance contract period would be the same as the warranty period for routine and emergency service. All labor and equipment costs shall be covered under this contract. Supplying contractor must state exact billing amounts, billing periods and all costs associated with this maintenance agreement and list any items that would not be covered under the service/maintenance agreement.

PART 2: PRODUCTS

2.1 MANUFACTURERS

A. The products specified shall be new and of the standard manufacture of a single, reputable, ISO 9001:2015 certified manufacturer.

1. Basis of Design: TekTone

2. Approved alternative manufacturer: Rauland-Borg Corporation

2.2 NETWORK WIRING

A. There shall be five (5) types of network wiring within the system.

1. P5 Patient Station Bus shall be CAT5 or better cabling wired using the T568B standard. Station bus wiring shall be comprised of:

2. Power, 3 pair 24 AWG (2 conductors). Note: CAT5-type cable shall be acceptable for use for Power wiring.

3. Data and Audio, 1 twisted pair 24 AWG (2 conductors). Note: CAT5-type cable shall be acceptable for use for Data and Audio wiring.

4. Dome Light Bus shall be CAT5 or better cable and 6P6C modular connectors wired straight through. One pair in the CAT5 cable shall remain unused. Wiring length of each dome light bus shall not exceed 50′. Each dome light bus shall have a maximum of two dome lights connected.

5. Peripheral Bus shall be #22AWG stranded wire. Each peripheral bus shall not exceed 50′ of wiring. Each peripheral bus shall have a maximum of 1 staff presence, 3 switches, and 4 auxiliary inputs per station peripheral bus.

6. P5 Master Station Bus shall be CAT5 or better cabling wired using the T568B standard. Station bus wiring shall be comprised of:

   a. Power, 3 pair 24 AWG (2 conductors). Note: CAT5-type cable shall be acceptable for use for Power wiring.

   b. Data and Audio, 1 twisted pair 24 AWG (2 conductors). Note: CAT5-type cable shall be acceptable for use for Data and Audio wiring.

   c. Plus one facility LAN connection and network cable

7. Tek-CARE® network wiring shall be CAT5 or better cable and 8P8C modular connectors wired straight through according to the T586B standard. The Tek-CARE® Network shall connect the NC455CE network ports to the NC475 Tek-CARE® Appliance Server.

2.3 CENTRAL EQUIPMENT (CE)

A. The contractor shall furnish, as shown on the plans, an NC455CE to furnish each nursing unit with the listed components as needed (numbers in parenthesis reflect maximums within an NC455CE). The NC455CE provides the following connections;

1. Tek-CARE Network connections (2)

2. Master Ports (2)

a. Each port supports up to 5 masters

3. Station Ports (2)

a. Each port supports up to 32 addressable stations / zone lights addresses

b. The system shall support additional modules required at a specific location by adding NC455CE Master & Station Modules as needed.

c. Each NC455CE shall include internal battery backup. In the event that a switch is made to battery power, a “BATTERY” message is displayed on the fault page at all associated master stations.

d. It shall be possible for each NC455CE Master & Station Module to act as a standalone controller for its local stations and master stations in the event of a loss of network communications. Should such a loss occur, the NC455CE Master & Station Module shall issue network faults to local master stations.

2.4 NURSE MASTER STATIONS (CONSOLES)

A. The contractor shall furnish, as shown on plans, Model NC404TS, a Nurse Master Station with 22" touchscreen color LCD Display. It shall be a self-contained unit, desk or wall mountable. Model NC404TS shall be capable of the following functions:

1. The touchscreen of the NC404TS shall be a convenient interface used to control, access, and program system features and calls displayed on the touch screen.

2. The touchscreen displays current calls and other data.

3. Full English display with user prompts.

4. Ability to display data on the current locations of staff.

5. Connectivity for a standard USB keyboard and/or mouse shall be supported via USB ports on the rear of the NC404TS master station.

6. The NC404TS shall display up to 5 incoming calls with the ability to select a call and/or scroll to any active call using the touch screen, each call with an individual elapsed timer which increments until the call is reset. Alternatively, calls and staff location may be displayed on station icons arranged by user preference into lockable positions on the touch screen.

7. The Master Station shall be able to receive and display any or all calls placed in the system, including simultaneous call types from the same room. Calls shall be sorted and displayed first by call priority and then by the chronological time in which the calls were placed.

8. There shall be at least 256 possible unique user-definable call types.

9. Choice of Push-to-Talk or private conversation using the handset.

10. Automatic answer of highest priority call or selective answer of any displayed call.

11. Set/Review up to four levels of service required—STAT Assist, Staff L1 (Green), Staff L2 (Amber) & Staff L3 (Yellow).

12. Three user accessible tone levels for Day and Night time levels.

13. Audio—master page, zone page and system page with staff level filtering options.

14. Optional tone silence by user definable call types. Silenced tones are regenerated whenever a new incoming call is received.

    a. Tone silence defaulted to “Routine” calls.

    b. Software shall be able to optionally defeat Tone Silence feature.

15. Ability to block loudspeaker paging per patient station to facilitate a low-noise patient environment. Password protection can be enabled to allow only authorized access to audio paging.

16. Ability to swing an individual room using convenient per-station zoning.

17. Ability to zone capture an individual nursing unit, selected units, or all units in facility by using custom-defined zones, per-master zoning and per-station zoning.

18. Ability to do day/night transfer between consoles by selecting or dialing a master and initiating a Master Forward.

19. Direct messaging (canned/custom) to pocket pager(s).

20. Locate up to three levels of staff with remote cancel of manual staff registration: Staff L1 (Green), Staff L2 (Amber) and Staff L3 (Yellow).

21. Continuously supervised with self-diagnosing error messages.

22. ESD protected to 8kV per UL®1069.

23. Consoles may be located anywhere within facility nurse/patient communications network.

24. Pleasant sounding call tones.

B. The contractor shall furnish, as shown on the plans, standard nurse console(s) NC415AV compact Master Station with an integral 5-inch touchscreen display and interface. It shall be a self-contained unit, with wall or desk mount options. When desk mounted, it shall not occupy more than 55 square inches of desk space with the following specifications:

1. This model Master Station shall be powered from the NC455CE Master & Station Module and does not require access to local AC power. Battery backup for switchover is provided from the NC455CE Master & Station Module.

2. Utilizes a 5" color touchscreen display.

3. Display up to 3 incoming calls (with the ability to scroll to any active call), each with an individual elapsed timer that increments until the call is reset.

4. The Master Station shall be able to receive and display any or all calls placed in the system, including simultaneous call types from the same room. Calls shall be sorted and displayed first by call priority and then by the chronological time in which the calls were placed.

5. There shall be at least 256 possible unique user-definable call types.

6. Choice of Push-to-Talk or private conversation using the handset.

7. Automatic answer of highest priority call or selective answer of any displayed call.

8. Set/Review up to four levels of service required—STAT Assist, Staff L1 (Green), Staff L2 (Amber) & Staff L3 (Yellow).

9. Audio—master page, zone page and system page with staff level filtering options.

10. Optional tone silence by user definable call types. Silenced tones are regenerated whenever a new incoming call is received.

    a. Tone silence defaulted to “Routine” calls.

    b. Software shall be able to optionally defeat Tone Silence feature.

11. Ability to block loudspeaker paging per patient station to facilitate a low-noise patient environment. Password protection can be enabled to allow only authorized access to audio paging.

12. Ability to zone capture an individual nursing unit, selected units, or all units in facility by using custom-defined zones, per-master zoning and per-station zoning.

13. Direct messaging (canned/custom) to pocket pager(s).

14. Locate up to three levels of staff with remote cancel of manual staff registration: Staff L1 (Green), Staff L2 (Amber) and Staff L3 (Yellow).

15. Continuously supervised with self-diagnosing error messages.

16. ESD protected to 8kV per UL®1069.

17. Consoles may be located anywhere within facility nurse/patient communications network.

18. Pleasant sounding programmable call tones.

C. Master Station firmware operates on TekTone’s operating system. Master Stations which utilize an outside supplier’s operating system where software failure (“lock-up”) may occur due to inconsistencies and incompatibilities between operating system and equipment supplier’s software, rather than operating in a firmware environment, shall not be accepted. All required software/firmware shall be supplied by TekTone.

D. Programming of Master Stations shall be done locally, or from a ConfigTool Live configurator, or from a Tek-CARE connected PC-based configuration tool.

E. It shall be possible to remove and/or replace any console(s) while the system is operational without the loss of any calls, damage to any system components, or reprogramming of console attributes.

2.5 BEDSIDE PATIENT STATIONS

A. The contractor shall provide single bed Model IR421P5 or dual bed Model IR422P5 as shown on plans. Each IR421P5 single or IR422P5 dual bedside patient station shall be capable of the following:

1. At least 256 completely custom configurable call types. Configurability shall extend to call labels/priorities/levels/tone-dome light annunciations.

2. Full-duplex audio with the master station from the handset.

3. Programmable 24-character patient name or label, plus an 8-character architectural room name that display at master station with other relevant call information.

4. Two levels of staff service.

5. Include IR421P5 single DIN jack patient stations as required.

6. Single station shall include at minimum:

a. One DIN jack

b. Three buttons; 2 CALL and 1 RESET

c. One ¼" phono jack (for call cord or other dry contact)

7. Include IR422P5 dual DIN jack patient stations as required.

8. Dual station shall include at minimum:

a. Two DIN jacks

b. One button; RESET

c. Two ¼" phono jacks (for call cords or other dry contacts)

9. Dummy plugs shall not be required to prevent calls from empty patient front panel station connectors. Systems that require dummy plugs to prevent calls are not acceptable. Patient stations must provide “cord-out” detection when call cords are used.

10. Full emergency and code blue supervision.

11. All peripheral device wiring shall terminate at the patient station. Systems requiring additional modules shall not be acceptable.

12. Meet or exceed UL®1069 Electrostatic Discharge (ESD) requirements with test verification performed by Underwriters Laboratories, Inc.

13. Plug-in pigtailed peripheral connections.

14. Provide interface to local equipment alarm contacts (i.e., ventilator, IV drip, fire detector, etc.) to notify master console of local alarm condition in patient room. Call identifications shall be programmable.

15. Support Dome Lamp Model LI484P5, designed to connect directly to patient station via current-limited station outputs.

16. Common call-reset button for all Routine, Priority and Upgraded calls placed from station and one call-placed LED per bed.

17. Continuous supervision for station power and data lines as well as data communications.

18. Ability to program on a per station basis, each bed and entertainment/call cord receptacle and/or bused peripheral input to a custom call type.

19. Ability to service exchange station “hot” (i.e., without removing system power or powering down local Central Equipment).

20. Patient station addressing shall be accomplished using simple dip switches. Methods that do not provide for simple dip switch addressing shall not be acceptable.

21. Patient station shall fit within a RACO 692 (or equivalent) housing when PM422AP5 module is not present. When module is used the assembly shall fit within the RACO 697 (or equivalent Steel City H3BD with #3GC ring) housing.

-or-

The contractor shall provide Model IR423P5 as shown on plans. Each IR423P5 bedside station shall perform the same functionality as the IR421P5 single station with the following feature differences:

a. In lieu of the DIN jack, the IR423P5 shall feature a 6' pull cord for call placement and

b. A momentary call button that may be used for check-in.

2.6 MULTIPURPOSE STATION

A. The contractor shall provide as required, a universal interface Model IR424P5 Multipurpose Station for standalone peripheral stations. Where shown on plans, this module may be used to drive corridor paging amplifier(s) via a grounded, shielded transformer (to prevent leakage current from being impressed on the isolated circuits of the nurse call system). Alternately, the IR424P5 may be connected directly to a 25-volt, ½-watt speaker for paging. Always use grounded, shielded transformers to prevent current leakage to the nurse call system's isolated circuits. This unit shall also be capable of providing auxiliary alarm device contacts inputs for nurse console notification of a local alarm(s) where necessary. It shall also provide the same peripheral inputs as patient stations.

2.7 STAFF STATION

A. The contractor shall provide as required, a Staff Station Model IR420P5.

1. Each IR420P5 staff station shall have a call button, emergency button, reset button and speaker for audio communication. Pressing the call or emergency button shall place a call to the assigned Master Station; optional programming shall allow the default staff-call type to be changed to any valid patient station call type.

2.8 DUTY STATIONS

A. The contractor shall provide as required, a Duty Station Model IR425P5.

1. Each IR425P5 duty station shall have a call button, reset button and a speaker for audio communication. Pressing the call or emergency button shall place a call to the assigned Master Station. In addition to the call and audio capabilities, the unit shall provide remote annunciation of assigned bedside patient stations and peripherals via four call placed LEDs (white, yellow, red and blue) and call tones; it shall drive an LI484P5 corridor light (in a zone lamp mode). The tones generated by the duty station shall be the same as the call tones generated by the master station. Duty stations that do not generate the same tones at the system's master station shall not be acceptable.

2.9 PERIPHERAL STATIONS

A. The contractor shall provide, as shown on plans, peripheral devices associated with multipurpose stations, bedside, staff, or duty stations that are wired via plug-in connectors. Individual peripheral devices shall be:

1. Waterproof Emergency pull-cord switch Model SF123 built in a single-gang ABS plastic Bezel with matching mounting plate. The SF123 utilizes a waterproof membrane faceplate with two button actuators and an optional 6-foot pull cord for call placement. Inserting optional button labeling allows the SF123 to be a code, emergency, bath or check-in switch.

2. Staff presence switch Model SF124 shall have four push buttons one each for three staff levels (i.e., Nurse, Aide and CNA) and one for a Staff Emergency call. When a staff member pushes the button, the associated LED and corridor lamp shall light. An existing patient call or service requirement shall be automatically canceled at time of registration and the staff may be located from any assigned nurse console.

3. Auxiliary input module Model PM123 shall provide two inputs capable of monitoring normally open dry contacts allowing the Tek-CARE400 P5+ Nurse Call Systems to monitor devices such as device alarm contacts, door contacts, security panel outputs, and more. There shall be two programmable behaviors; Follower and Acknowledge, which are programmable using the LS450 Config Tool.

2.10 CORRIDOR LIGHT SETS

The contractor shall:

A. Provide corridor lights model LI484P5 as shown on plans. The corridor light shall be sectional in design, with a flame-retardant translucent plastic lens mounted on a flame retardant (UL®94 HB) plastic base panel. Dome light indications shall be provided by four multicolored LEDs that indicate patient call priority and staff presence. The dome light shall be programmable to produce any of eight colors: white, pink, red, orange, yellow, green, blue and purple. Each section of the LI484P5 shall be programmable with a primary and secondary color per any of 256 user definable call types. Wiring connections shall be plug-in.

B. It shall be possible to connect a secondary LI484P5 Corridor Light to the Primary LI484P5. The Secondary LI484P5 mimics the call indications of the primary LI484P5 so that calls from a single room can be displayed in two locations. Systems that do not support secondary corridor lights are not acceptable.

C. The LI484P5 may be used as a zone light by adding a PM484ZP5 Zone Light Module or an IR425P5 Duty Station. The PM484ZP5 shall support one Bath and one Code input to be used when a standalone switch is required.

2.11 TEK-CARE® APPLIANCE SERVER

The contractor shall:

A. The contractor shall furnish an **NC475 Tek-CARE® Appliance Server** with Tek-CARE software as required.

B. Proprietary nurse call appliance server running the Tek-CARE OS. The Tek-CARE® Appliance Server is available in two variants.

1. The NC475 is a headless appliance server.

2. The NC475DESK is supplied with a touchscreen monitor, and wireless keyboard and mouse.

C. The NC475 can function as the primary master station for a Tek-CARE system.

D. The Tek-CARE® Appliance Server shall sound an audible alarm when a call is placed, and staff shall be notified via the LCD display or Touchscreen Monitor if installed of the call type and room number.

E. Includes paging software module for automatic and manual pages to staff.

F. Software module choices include event monitoring, reporting, Staff App, Apple TV displays, email output, Tek-CARE® Event Monitor App for Windows, and more.

G. The Tek-CARE System with NC475 shall be able to support up to 254 Tek-CARE® Event Monitor App for Windows, 255 Apple TVs and 255 Mobile Apps.

H. Tek-CARE® Appliance Server shall interface with the optional Tek-PAGING® Radio Pocket Paging System.

I. Backup power for the Tek-CARE® Appliance Server shall be supplied by an uninterruptable power supply (UPS). The UPS shall be TekTone PK250B.

J. The Tek-CARE® Appliance Server shall be capable of being configured to provide the features shown in the following sections.

2.12 CALL ESCALATION

A. The nurse call system shall support eight levels of call escalation. The time periods may be specified by the end user. Escalation shall be possible to a master station, text, or email. Installing contractor shall verify configuration required by Texas GLO. Escalation parameters shall be identical to those currently in use at existing Texas State VA homes.

2.13 TEK-CARE® EVENT MONITOR APP FOR WINDOWS SOFTWARE

A. The Nurse Call System shall support an optional remote Tek-CARE® Event Monitor App for Windows that may be installed on any networked facility personal computer running Windows 7 or higher. The Tek-CARE® Event Monitor App for Windows requires that the Tek-CARE® Appliance Server be connected via LAN and properly licensed.

B. The Tek-CARE® Event Monitor App for Windows is used to remotely display and manage calls received by the Nurse Call System. The Tek-CARE® Event Monitor App for Windows shall display all calls from connected Nurse Call Systems as well as Nurse Call System faults. The Tek-CARE® Event Monitor App for Windows software shall be TekTone LS623-series.

C. The Tek-CARE® Appliance Server shall be configured using LS450 configuration software for setup and programming. The configuration software shall enable programming of all licensed system features.

2.14 CONFIGURATION SOFTWARE; CONFIGTOOL LS450

A. The Tek-CARE® Appliance Server shall be configured using LS450 configuration software for setup and programming. The configuration software shall enable programming of all licensed system features.

2.15 CONFIGURATION SOFTWARE; CONFIGTOOL LIVE LS454

A. The LS454 software shall also enable users to view information about the system, including patients, staff, staff groups, staff assignments, and scheduled messaging and make limited changes to the system configuration while the system is up a running (Live).

B. The LS454 may also be used as a remote monitor from one location.

2.16 REPORTING SYSTEM

A. A reporting system that is operationally transparent to the Nurse Call System shall be provided with the system. The reporting database shall automatically log system events and store them for retrieval at a later date.

B. Any event that is annunciated by the system shall be automatically logged in the reporting database. The database shall record all system activity for review at a later time using the optional Reporting software. The database shall record all information about the event, including response time and the time and date of the event. No action by the user shall be necessary to record system events. The database shall not require any maintenance or periodic cleanup by the user.

C. The reporting system can be accessed by any of the following; a PC on the network accessing the NC475 Tek-CARE® Server, a Tek-CARE® Event Monitor App for Windows and the ConfigTool Live running on networked PCs.

D. Report creation shall be simple and completely customizable. Reports shall be viewable in a web browser as an HTML file or exported as a CSV file. The reporting system shall have quick links for creating commonly requested report ranges (last day, last week, etc.) as well as offering fully customizable report creation.

1. Using the optional LS453 Email Output software, the reporting system shall be capable of generating reports and distributing them automatically via email.

2. The reporting system shall be available as an optional feature and shall be TekTone LS610 series.

2.17 POCKET PAGING

The contractor shall;

A. Provide a pocket paging transmitter and alphanumeric pagers, or LED Messaging Sign. The transmitter shall be capable of being connected to the Nurse Call System via the Tek-CARE® Appliance Server, and shall be operationally transparent to the Nurse Call System. The pocket paging interface shall allow COMP2, TAP and Scope protocols. The pocket paging equipment shall support the following features:

1. The Nurse Call System shall accommodate up to 256 unique pager cap codes. Each pager cap code may be given a name describing it and/or the staff member who carries it. Each pager may belong to multiple pager groups, of which the system shall allow up to 255.

2. The system shall allow four types of paging assignment:

a. From a station to a pager

b. From a station to a pager group

c. From a zone to a pager

d. From a zone to a pager group

3. Each assignment shall have the following properties:

a. Level—whether the assignment is primary, secondary, or tertiary

b. Call filter—the call types to which the assignment applies

c. Page resets—whether the assignment applies to resets

d. Page faults—whether the assignment applies to faults

4. Paging assignments shall be fully configurable from the nurse call master station, remote event monitors and from the Tek-CARE® Appliance Server running the ConfigTool programming software.

B. The system shall allow two types of paging: manual and automatic. Automatic paging may be turned off or on; when on, it shall operate concurrently with manual paging.

C. Manual paging shall be executed either from the integration server, event monitor apps or a nurse call master station. At any time, the attendant may page by pager, pager group, station or zone. For convenience, system paging shall also be directly supported. Paging by station or zone shall occur through that station's or zone's paging assignments. For a station page, the attendant may select the levels of assignment (primary, secondary and/or tertiary) to be used in the page. For a call-related page, the default page message shall include information about the call, including the call type and room number requiring assistance. The attendant may edit the message or make use of a pre-programmed list of patient needs.

D. Automatic paging shall be governed by paging assignments. When a call is placed from a patient station, the system shall automatically page pagers or pager groups assigned to that station or its zones. The properties of each assignment shall determine its applicability to the page, ensuring that pages reach exactly the staff members they concern. For example, a call of a particular type shall activate only those assignments whose call filters allow that type. For each call, automatic paging shall begin at the primary level and repeat at regular intervals. If the call is not reset, the page shall escalate to include up to 8 levels. The pager shall display the location where the call originated (room ID), as well as the call type. Call resets and faults may also be paged automatically.

E. Systems that require additional software or licensing to enable paging shall not be acceptable.

1. The transmitter shall be TekTone NC365B.

2. The alphanumeric pager shall be TekTone NC397A.

3. The LED messaging sign shall be TekTone SI005.

2.18 EMAIL OUTPUT

The contractor shall provide:

A. An interface to the facility's mail server that routes calls via an unauthenticated SMTP route from the nurse call system to email addresses as required.

B. The email output software shall enable real-time event notifications to be sent to email addresses and any device with an email gateway.

C. The email output software shall allow users to create scheduled reports that are emailed directly to the specified users.

1. The email output software shall be available as an optional feature and shall be TekTone LS453.

2.19 TEK-CARE® STAFF APP INTEGRATION

A. The contractor shall provide, as required, an interface to up to 255 mobile Android, Apple iPod Touch® and iPhone® devices and/or up to 255 Apple TV® devices. The required non-voice Staff App server shall be TekTone LS620 and the non-voice app licenses shall be TekTone LS621-series. The required voice Staff App server shall be TekTone LS630 and the voice app licenses shall be TekTone LS631-series. The Apple TV® interface shall be TekTone LS622-series.

B. The Staff App integration shall display calls placed on the Nurse Call System to improve staff efficiency and awareness. With the voice-enabled app, it shall be possible to answer calls and speak directly to residents and patient speaker type stations installed. The Staff App integrations shall only function when connected to the facility's wireless LAN. Staff App integrations that allow access to system calls when the mobile device is not on facility premises shall not be accepted.

C. Apple TV® devices and Mobile client assignments shall be configurable in the same way as the radio pagers can be. Messaging shall be automatic and support manual messaging.

D. The Staff App operates as a staff device on the Tek-CARE® system, allowing each individual app to be configured for a particular staff member's need.

2.20 FOREIGN SYSTEMS INTEGRATION

The contractor shall:

A. Provide, as required, the LS600 Tek-ALERT® software and appropriate connection hardware to enable the Nurse Call System to monitor and display calls and status of connected foreign systems such as security systems, fire alarm systems, and more.

B. The monitored foreign system must supply an accessible data stream via one of the following protocols: Serial (event printing, Scope paging, ContactID), COMP2, TAP, HL7, TCP/IP, TCP/IP Listener or UDP. Contact TekTone if a protocol is not listed, as protocol libraries will grow.

C. Foreign Systems Integration shall support the following features:

1. Once properly configured, the Tek-ALERT Integration Manager shall receive events from monitored foreign systems and annunciate the events on the Nurse Call System.

2. Events from monitored foreign systems shall appear in the reports created by the Tek-CARE Reporting System. These events may also be sent to pagers/apps as configured in assignment settings.

3. The Tek-ALERT Integration Manager shall not be used as the primary annunciation point for monitored foreign systems, but shall function as a secondary annunciation point. Tek-ALERT programming and use shall not interfere with the primary annunciation settings of the monitored foreign system(s).

2.21 MEDIA GATEWAY SERVER LICENSE

The contractor shall provide, as required:

A. A Media Gateway license, model LS460, to provide call and event notifications via the Tek-CARE® Appliance Server to facility VoIP extensions and deliver pertinent information on the telephone display. It shall provide protocol conversion between TekTone's audio manager and a facility PBX that uses SIP G.711 as the primary protocol.

B. The LS460 also shall support two-way voice communication between patient room stations and facility VoIP extensions.

C. The Media Gateway, shall be capable of connecting to both the PBX network and Tek-CARE Network and shall be operationally transparent to the nurse call system.

D. The interface shall support the following features:

1. Provides up to 36 audio paths

2. Display of patient or resident nurse call alarms

3. Accept incoming voice calls from the nurse call system

4. Reset a nurse call alarm (low priority only and can be enabled or disabled)

5. In-call options (connected call)

a. Place a Level 1, 2 or 3 service request

b. Place a STAT call

6. Place a call to a room station, zone or master

7. Receive manual text messages from a master or remote monitor

8. Software updates along with any other nurse call system module update

E. Telephone extension assignments shall be configurable in the same way as the radio pagers can be and support manual messaging.

2.22 ADT INTERFACE USING THE HL7 STANDARD SOFTWARE

The contractor shall:

A. Provide an HL7 (v. 2.3) compliant interface for the purpose of receiving relevant patient information from the facility's Admit, Discharge, Transfer system. Relevant patient information shall include patient name, room number, bed number and doctor name.

The interface shall:

B. Insert standard ADT field information into nurse call system fields.

C. Update in real time.

D. The ADT Interface software shall be available as an optional feature and shall be TekTone LS452.

2.23 SYSTEM DIAGNOSTICS

A. All Network modules and Apps, Nurse Master Stations and IR400-series stations in the system shall be continuously supervised for power and data. Each IR400-series station shall in turn monitor its peripheral bus devices and dome lamps as previously specified. All system faults shall be annunciated on a Nurse Master Station with pertinent information as to the type and location of fault.

PART 3: EXECUTION

3.1 SUPERVISION

A. Only TekTone factory-certified installers shall install, service, and maintain the specified network system.

B. The manufacturer shall have the equipment manufacturer's engineer or their designated agent inspect the installation and operation of this network to determine that the network complies with all standards listed in Section 2.3.

3.2 IN-SERVICE TRAINING

A. The contractor shall provide thorough training of all nursing staff assigned to those nursing units receiving newly networked nurse/patient communications equipment. This training shall be developed and implemented to address two different types of staff: floor nurses/staff shall receive training that is specific to their tasks and responsibilities, and similarly, unit secretaries (or any person whose specific responsibilities include answering patient calls and dispatching staff) shall receive operational training from their perspective. A separate training room shall be set up that allows this type of individualized training utilizing in-service training unit, prior to the turning over of the new system.

3.3 WIRING

A. The contractor shall terminate all wiring with manufacturer's approved connectors. The use of wire nuts is prohibited.

B. All wiring shall be free from shorts and faults. Wiring shall be UL® Listed, and installed in accordance with ANSI/NFPA 70, Article 25 and applicable sections of ANSI/NFPA 99, and compliant with the manufacturer's installation and maintenance manual and specifications.

C. Nurse patient communications network wiring shall not be run in the same conduit with other systems (e.g.: Class 1 AC power distribution, fire alarm, entertainment systems, lighting controls, etc.).

3.4 ELECTRICAL POWER CONNECTIONS

A. It shall be the responsibility of the facility to provide a dedicated 120 VAC, 60 Hz conduit feed into the equipment cabinet. This power feed shall not have any other devices connected to it. A 20-amp circuit breaker shall be located in the electrical sub-panel. This circuit breaker shall be labeled "Nurse Call" along with identification of the Nursing Unit that shall be controlled by this circuit breaker. This electrical circuit shall be connected to the facility's emergency power system for automatic power switchover during loss of utility power.

B. Connect all network system power supplies and equipment cabinets to a common earth ground approved for the application utilizing a 14 AWG or larger solid conductor which is at minimum the same conductor size as the AC feed wires.

3.5 ENVIRONMENTAL PROTECTION

A. The installing contractor shall make certain that all central equipment is accessible for service. Contractor shall notify specifying authority if designated equipment closet does not meet manufacturer's requirements for heat, radiation or static electricity.

3.6 PROTECTION OF NETWORK DEVICES

A. The contractor shall protect network devices during unpacking and installation by wearing manufacturer-approved ESD wrist straps tied to earth ground. The wrist strap shall meet OSHA requirements for prevention of electrical shock if technician comes in contact with high voltage.

3.7 CLEANING AND PATCHING

A. It shall be the responsibility of the contractor to keep the work area clear of debris and to clean area daily at completion of work.

B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.

3.8 DRAWINGS

A. Provide as-built drawings of all installed network components and associated wiring on building plans. Final payment for work will not be authorized unless these drawings are supplied.

END OF SECTION 27 52 23

SECTION 28 13 00 - ELECTRONIC ACCESS CONTROL SYSTEM

PART 1 – GENERAL

1.1 WORK INCLUDED

A. The contractor shall furnish and install a complete microprocessor-based access control system as specified herein. The system shall include, but not be limited to, all control equipment, signal initiating, and signaling devices, conduit, wire, fittings, labor and all other accessories required to provide a fully functioning system.

1.2 CODES AND STANDARDS

A. The system shall comply with the applicable Codes and Standards as follows:
   1. National Fire Protection Association Standards:
      a. NFPA 70 National Electric Code
      b. NFPA 72 National Fire Alarm Code
      c. NFPA 101 Life Safety Code

B. Local & State Building Codes

C. Requirements of Local Authorities having Jurisdiction

D. Underwriters Laboratory Requirements and Listings for use in Security Alarm Systems.

E. Requirements of American Disabilities Act (Public law 101-336).

F. State Fire Marshal.

G. Louisiana Insurance Code.

1.3 RELATED WORK

A. Division 08 – Door Hardware

1.4 DEFINITIONS

A. ACS – Access Control System

B. CSA – Client Software Application

C. DGM – Dynamic Graphical Maps
D. ALPR – License Plate Recognition

E. SDK – Software Development Kit

F. SMA – Software Maintenance Agreement

G. SSM – Server Software Module

H. UI – User Interface

I. USP – Unified Security Platform

J. USW – Unified Web Client

K. VMS – Video Management System

L. DVS – Digital Video Server

1.5 QUALITY ASSURANCE

A. Contractor Qualifications:
   1. The installing contractor shall be the authorized representative of the access control system manufacturer to sell, install, and service the proposed manufacturer's equipment.
   2. The installing contractor shall be licensed by the State of Louisiana as a security services contractor to design, sell, install, and service security alarm systems.
   3. The installing contractor shall provide 24-hour, 365 day per year emergency service with factory trained service technicians.
   4. The installing contractor shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten (10) years.
   5. Absolutely no subcontracting of any portion of this system by the proposing contractor will be allowed.
   6. Must be a current integrator of solution in Louisiana marketplace, have a permanent office located within 150 miles of the Project, and be able to include information on current support staff to be able to service this client.

B. All Contractors shall submit to the Owner prior to starting any work the factory training certificates for all personnel that will be working on the access control system. No person can work on the system without proper manufacturer's certification.

1.6 SUBMITTALS

A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
   1. Control panel wiring and interconnection schematics.
   2. Complete point to point wiring diagrams.
   3. Riser diagrams.
   4. Complete floor plan drawings locating all system devices.
   5. Factory data sheets on each piece of equipment proposed.
   6. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
   7. Complete system bill of material.
   8. Line by line specification review stating compliance or deviation.

B. All submittal data will be in electronic form with contractor's name, supplier's name, project name and state security license number adequately identified.

PART 2 – PRODUCTS

2.1 ACCESS CONTROL EQUIPMENT

A. Head-End/Software
   1. Brivo Access or approved equal.

B. Controllers

1. Mercury
2. Allegion

C. Card Readers
1. HID iClass SE R10 for mullion mounted applications
2. HID iClass SE R40 for wall-mounted applications.

D. Wiring
1. Belden
2. Windy City Wire
3. West Penn

E. Power
1. LifeSafety Power
2. Altronix

J. Credentials
1. Provide 500 HID prox cards

2.2 NETWORK VIDEO INTERCOM SYSTEM

A. Contractor shall provide a network-based communication Video Intercom system with integrated door control and IP phone integration. Provide a complete system for each location shown on drawings.
1. Axis I8016-LVE or approved equal
a. Integrate with owner's IP phone system.
b. Integrate with access control system for door release.

2.3 PERFORMANCE REQUIREMENTS

A. Controllers:
1. Access Control
a. Mercury LP1502

B. Card Readers/Hardware
1. Reference Division 8 for all necessary interfaces to card readers and locks..

C. Wiring
1. Plenum Rated
2. Minimum of 18AWG

D. Power
1. 120V power shall be provided in each location necessary to facilitate all access control panels and power supplies. All power supplies shall include UPS backup for all door hardware. UPS backup to be for (2) hours.

PART 3 – EXECUTION

3.1 GENERAL

A. The contractor shall have furnished and installed a complete microprocessor-based access control system as specified herein. The system shall include, but not be limited to, all control equipment, power circuits, signal initiating and signaling devices, door hardware,

conduit, wire, fittings, labor and all other accessories required to provide a fully functioning system.

3.2 HARDWARE INSTALLATION

A. General
1. Provide mock-up of a typical entry door, complete with conduit, outlet boxes, cables and access control devices prior to installation.
2. All security conduit as required for a complete installation of this system shall be provided as specified in Division 26.
3. Coordination with the Division 26 is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
4. All door hardware to be coordinated with Division 08, reference Division 08 for hardware requirements.
5. All controllers and power supplies shall be installed in the MDF room.

B. Wiring/Conduit
1. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
2. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
3. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
4. All wire shall be installed in an approved conduit/raceway system in walls and inaccessible locations. Cabling is allowed in accessible ceiling space.
5. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
6. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
7. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors traversing the respective box as well as the number of terminations required.
8. All plenum wiring is to be installed parallel and perpendicular to the building structure. Install wiring tight up against structure for protection. Cable shall be bundled on a maximum of 2'-6" and secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated cable ties.
9. Contractor is required to provide all mapping and software configuration required to operate system as per manufacturer’s recommendations.
10. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated j-hook style cable support system for the entire run of each cable. Including, but not limited to service loops
11. The cable support system shall be attached directly to the building steel at a serviceable height. If the building steel is not within 5’ of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5’ of the finished ceiling and mount the support hook to the treaded rod.

C. System

1. Furnish and install one (1) card reader license for each location shown on drawings
2. Contractor shall furnish and install quantity of hardware as specified in Division 28. All controllers, and cabling shall be installed be routed in locations from devices to the nearest data closet, as shown.
3. Provide an additional sixteen (16) hours of programming, coordinate final programming with owner.

3.3 TESTING

A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Electrical Contractor and performed by the equipment supplier. Final test report shall be received and acknowledged by the Owner prior to substantial completion.

B. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.

3.4 WARRANTY

A. Contractor shall provide minimum of one (1) year warranty of workmanship and product. Must support (24) hour turn time to fix and/or replace any system issues or hardware.

B. The product shall perform in all material respects in accordance with the accompanying user manual, and the media on which the Software Product resides will be free from defects in materials and workmanship under normal use. Software defects are covered through Service Releases and Cumulative Updates which are available for a period of 1 year from the date of substantial completion.

END OF SECTION 28 13 00

SECTION 28 31 11 - FIRE ALARM SYSTEM WITH VOICE EVACUATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes fire alarm systems.

B. Definitions:

1. FACP: Fire alarm control panel.
2. LED: Light-emitting diode.
3. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

C. System Description:

1. Noncoded, Analog addressable system; multiplexed signal transmission dedicated to fire alarm service only.

D. Performance Requirements:

1. Comply with NFPA 72 latest edition or edition enforced by state or local code authority.
2. Fire alarm signal initiation shall be by one or more of the following devices:

a. Manual stations.
b. Heat detectors.
c. Smoke detectors.
d. Automatic sprinkler system water flow.

3. Fire alarm signal shall initiate the following actions:

a. Alarm notification appliances shall operate continuously and be synchronized as required per code.
b. Identify alarm at the FACP and remote annunciators.
c. Transmit an alarm signal to the remote alarm receiving station.
d. Shut down heating, ventilating, and air-conditioning equipment over 2000 cfm.
e. Record events in the system memory.

4. Supervisory signal initiation shall be by one or more of the following devices or actions:

a. Operation of a fire-protection system valve tamper.

5. System trouble signal initiation shall be by one or more of the following devices or actions:

a. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
b. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
c. Loss of primary power at the FACP.
d. Ground or a single break in FACP internal circuits.
e. Abnormal ac voltage at the FACP.
f. A break in standby battery circuitry.

g. Failure of battery charging.
h. Abnormal position of any switch at the FACP or annunciator.

6. Resetting of other systems:

a. Resetting of duct detectors shall be from the panel.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
2. Device Address List: Coordinate with final system programming.
3. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
4. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
5. Batteries: Size calculations.
6. CAD drawings with device locations, device ratings, cable routing, cable size/type, etc. indicated on floor plans.
7. All shop drawings are to be electronic in nature and submitted in PDF form. Paper shop drawings will not be reviewed.

C. Field quality-control test reports per NFPA 72.

D. Operation and maintenance data.

E. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Complete all required form. Contractor is responsible for all required fees. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review. All drawings shall be done in AutoCAD R14 format or newer.

F. All fire alarm drawings are to be submitted digitally. Fire alarm devices with any notation are to clearly stand out from the floor plan by using a bolder line width contrasting a screened floorplan. Devices and notation are to be proportionally sized to the scale of the drawing. Fire alarm devices only are to be indicated on drawings, drawings are not to be shared with electrical devices or any other discipline.

G. Documentation:

1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.
2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.

a. Electronic media shall be provided to Architect and authorities having jurisdiction.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project and shall be supervised by a Nicet Level III Supervisor.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. FACP and Equipment:

a. Siemens.
b. Silent Knight
c. Notifier.
d. Fire Lite.
e. EST.

2. Wire and Cable:

a. Comtran Corporation.
b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
d. West Penn Wire/CDT; a division of Cable Design Technologies.
e. Coleman Cable.

2.2 FACP

A. General Description:

1. Modular, power-limited design with electronic modules, UL 864 listed.
2. Analog addressable control circuits for operation of mechanical equipment.
3. System shall be sized for the number of points indicated plus (20) twenty percent spare.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Circuits:

1. Signaling Line Circuits: NFPA 72, Class B, Style 4.

2. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.
3. Circuits shall be configured with loop isolators.
4. Actuation of alarm notification appliances, annunciation, and elevator recall shall occur within 10 seconds after the activation of an initiating device.
5. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.

D. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.

E. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

F. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote annunciators, after initiating devices are restored to normal.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.

3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

G. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter. The system shall be capable of communicating and telephone lines.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory signal and supervisory and digital alarm communicator transmitter and digital alarm radio transmitter shall be powered by the 24-V dc source.

1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
1. Power supply shall have a dedicated fused safety switch or circuit breaker for this connection at the service entrance equipment. The switch box or circuit breaker shall have red marking identify it with "FIRE ALARM SYSTEM POWER." Where a circuit breaker is the disconnecting means, an approved breaker locking device shall be installed.

2. Provide surge protection on all 120 volt power serving fire alarm equipment.

J. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.

1. Battery and Charger Capacity: Comply with NFPA 72.
2. Provide surge protectors on all circuits.

K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

L. Voice/Alarm Signaling Service: A central emergency communication system with supervised microphone, preamplifier, amplifier, and tone generator provided in a separate cabinet or as a special module that is part of the FACP.

1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones, or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall be UL 1711 listed.

a. Allow the application of and evacuation signal to indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
b. Programmable tone and message sequence selection.
c. Standard digitally recorded messages for "Evacuation" and "All Clear."
d. Generate tones to be sequenced with audio messages of the type recommended by NFPA 72 and that are compatible with tone patterns of the notification-appliance circuits of the FACP.

2. Notification-Appliance Circuits: NFPA 72, Class B.
3. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.

2.3 MANUAL FIRE ALARM PULL STATION

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
2. Station Reset: Key- or wrench-operated switch.

2.4 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
3. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.

B. Multi Criteria Detectors:
1. Minimum of photoelectric and heat.
2. Sensor: LED or infrared light source with matching silicon-cell receiver.
3. Photoelectric Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
4. Thermal detection.

C. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.

D. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:

   a. Sensor: LED or infrared light source with matching silicon-cell receiver.
   b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.

2. UL 268A listed, operating at 24-V dc, nominal.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
7. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
8. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.5 HEAT DETECTORS

A. General: UL 521 listed.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or rate-of-rise of temperature that exceeds 15 deg F (8 deg C) per minute, unless otherwise indicated.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.6 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly. Factory standard color by Architect (Red or Beige).

B. Voice/Tone Speakers:

1. UL 1480 listed.
2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Mounting: Flush, semi-recessed, or surface mounted; bidirectional as indicated.
5. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.

C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output: Candela indicated on drawings.
2. Strobe Leads: Factory connected to screw terminals.
3. Where multiple visual notification appliances can be seen from any location, circuitry shall be incorporated for the synchronization of flash rate.
4. Adjustable Strobes-Field selectable from 15cd, 30cd, 75cd, 110cd.

2.7 SPRINKLER SYSTEM REMOTE INDICATORS

A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.8 REMOTE ANNUNCIATOR

A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Class 1.

B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.9 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to the elevator controller to initiate elevator recall and to a circuit-breaker shunt trip for power shutdown.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Listed and labeled according to UL 632.

B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated. The contractor shall provide conduit and cable to telephone backboard and make final connections to telephone service.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.

D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.11 CELLULAR COMMUNICATOR TRANSMITTER

A. Napco Starlink Fire LTE Commercial or approved equal.

B. UL Listed.

C. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically communicates to the central station. When contact is made with the central station(s), the signal is transmitted.

D. If needed remote antennas shall be installed to allow for communications to monitoring company.

E. Communicator shall be compatible with the owner’s monitoring company.

F. Communicator shall be powered by the FACP.

G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 NETWORK COMMUNICATIONS

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide integration gateway using BACnet and Modbus protocol for connection to building automation system.

2.13 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

1. Twisted shielded pair, NFPA 70 Article 760, UL listed as Type FPLP, plenum rated and complying with requirements in UL 1424.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.

B. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.

C. Audible Alarm-Indicating Devices: Install per NFPA 72. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

D. Visible Alarm-Indicating Devices: Install per NFPA 72.

E. FACP: Surface mount with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

F. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

G. The contractor shall provide the following spare devices at a location determined by the engineer or fire marshal prior to final approval of shop drawings. Contractor shall be responsible for all conduit, wire, battery, cards etc. needed to install these spare devices. Devices not used shall be delivered to the owner as spare. Devices: 6 - speaker/strobes (any candela), 2 - pull stations, 4 - smoke detectors, and 4 - control modules.

3.2 WIRING INSTALLATION

A. Install wiring according to the following:
1. NECA 1.
2. TIA/EIA 568-A.

B. Wiring Method:

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable. Cable installed in plenum ceiling spaces shall be plenum rated. Fire alarm cable installed in walls, exposed areas or in inaccessible spaces shall be in conduit. All cable and conduit shall be concealed where possible.

2. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to "Basic Electrical Materials and Methods Electrical Identification."

B. Install instructions frame in a location visible from the FACP.

C. Paint power-supply disconnect switch red and label "FIRE ALARM CIRCUIT CONTROL."

3.4 GROUNDING

A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters.
3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.

4. Testing: Follow procedure and record results complying with requirements in NFPA 72.

   a Detectors that are outside their marked sensitivity range shall be replaced.

5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Provide a minimum of 2 hours of training to the Owner’s Representative.

M & E Consulting, Inc.
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Lafayette, LA 70506
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CADD/Electronic File Transfer to Contractor for M&E Drawings.

Dear Contractor:

At your request, we will provide electronic files for your convenience and use in the preparation of shop drawings related to _____ , subject to the following terms and conditions:

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(PLEASE INDICATE DRAWINGS NEEDED):

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_____

(Date) **(Contractor name and firm name)**

_____

_____

(e-mail address) **(Contractor signature)**

Please complete this form completely and email or fax to (337)234-7774.

END OF SECTION 28 31 11

SECTION 31 2000 – EARTH MOVING (BUILDING PAD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section

B. Geotechnical Investigation by Premier Geotech & Testing, LLC., dated May 12, 2023. Geotechnical report may be obtained from Architect's office.

1.2 SUMMARY

A. This Section includes the following:
   1. Preparing subgrades for buildings.
   2. Excavating and backfilling for buildings and structures.
   3. Drainage course for slabs-on-grade.
   4. Subbase course for concrete walks and pavements.
   5. Excavating and backfilling for utility trenches.
   6. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:
   1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
   2. Division 03 Section "Cast-in-Place Concrete".

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Drainage Course: Course beneath the slab that minimizes upward capillary flow of pore water.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

H. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

I. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.
2. Test reports on borrow material.
3. Field density test reports.
4. One optimum moisture-maximum density curve for each type of soil encountered.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Perform work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

C. Testing & Inspection Service: Owner will engage and pay for soil testing and inspection service for quality control testing during earthwork operations. Contractor shall pay for all retesting of failed tests.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Existing Utilities: Locate existing underground utilities before performing earthwork. If utilities are to remain in place, provide protection from damage during earthwork operations.

C. Interuption of Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

D. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soils:
1. Imported soil fill material used to raise the site grade should be either a low plasticity silty or sandy clay (USCS Classification, CL) or a clayey sand (SC), shall be free of roots, construction debris, organic matter or any other deleterious materials, have a maximum clay lump size less than two (2) inches and have a liquid limit of less than 40 and a plasticity index value between 12 and 22. If a fine-grained sandy clay soil is used for select fill, close moisture content control will be required to achieve the recommended degree of compaction.

B. Unsatisfactory Soils: Soils other than satisfactory soils.
1. Unsatisfactory soils also include **satisfactory soils not maintained within -2 to +2 percentage points of the optimum moisture content at time of compaction as determined by the Standard Proctor test (ASTM D 698).**

C. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

D. Drainage Course: Provide a stone drainage layer (per list below) at contractor’s option beneath the concrete slab and vapor retarder.

1. A 4” thick layer number 8 washed gravel per ASTM C33, complying with the following gradation:

Sieve Size	Percent Passing
1/2”	100
3/8”	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

2. A 4” thick layer of number 57 crushed and washed limestone per ASTM C33. complying with the following gradation:

Sieve Size	Percent Passing
1-1/2”	100
1”	95 to 100
1/2"	25 to 60
No. 4	0 to 10
No. 8	0 to 5

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
   1. Red: Electric.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
   1. Red: Electric.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. In order to prepare the building and pavement areas for fill or for insitu soils to be used as a final subgrade, the site shall be stripped of all vegetation, soft or loose surface soils, obstructions and all deleterious materials. This includes any loose or water-softened surface materials.

1. If applicable, when trees are removed, the entire root ball should be excavated such that the remaining roots measure 1 inch in diameter, or less.

C. Additional information for preparation requirements of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface, and treatment or improvement are specified in Division 2 Section "Site Clearing." Also refer to Geotechnical Investigation for additional information on site work and subgrade preparations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

E. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated materials as directed by Architect.

F. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction (including all OSHA requirements). Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. Avoid opening excavations during inclement weather.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
3. The base of all excavations for structures shall be free of water, loose soil, unsuitable bearing materials including soft soil, and other foreign materials.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
   1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
   1. For pipes and conduit less than 8 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
   2. For pipes and conduit 8 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill. Alternatively, excavate the trench 6” deeper than the bottom of the pipe and provide 6” bedding course.
   3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll existing subgrade (after preparation as noted above is complete) below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Contact Architect, Engineer, and Testing Agency 48 hours prior to proof-rolling. A representative of the Testing Agency must be on site during proof-rolling operations.
   2. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
   3. Proof-roll with a half loaded 10-wheel, tandem-axle dump truck weighing not less than 25 tons.
   4. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Testing Agency and as directed by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2000 psi, may be used when approved by Architect.
   1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for Record Documents.
   3. Testing and inspecting underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring and bracing, and sheeting.
   7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with a lean concrete fill to elevation of bottom of footings. Provide a lean concrete fill with a 28-day compressive strength of 2500 psi.

D. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

E. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

G. Place and compact final backfill of satisfactory soil to final subgrade elevation.

H. All utility trenches that penetrate the building shall be effectively sealed to restrict water intrusion and flow through trenches that could migrate below the building. An effective clay “trench plug” that extends at least five (5) feet out from the face of the building exterior shall be constructed at each utility trench which penetrates the building perimeter. The plug material shall be a clay satisfactory soil compacted at a water content at or above the soils optimum water content. The clay satisfactory soil shall be placed to completely surround the utility line and be compacted.

I. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use satisfactory soil material.
   4. Under building slabs, use satisfactory soil material.
   5. Under footings and foundations, use satisfactory soil material

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within -2 to +2 percentage points of the optimum moisture content at time of compaction as determined by the Standard Proctor test (ASTM D 698).
   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds the optimum moisture content allowance stated above and is too wet to compact to the specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials only after the site has been proof-rolled.

B. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

C. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

D. Compact all satisfactory soil materials to at least 95 percent of the maximum dry density as determined by the Standard Proctor compaction test (ASTM D 698).

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
   3. Compact grading fill materials outside of building slab limits to at least 90 percent of the maximum dry density as determined by the Standard Proctor compaction test (ASTM D 698).

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 1 inch.
   2. Walks: Plus or minus 1 inch.
   3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
   1. Shape subbase and base course to required crown elevations and cross-slope grades.
   2. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
   3. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials.

3.18 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Subgrade shall be inspected by Testing Agency after compacted fill is complete and immediately prior to placement of drainage course.

B. Provide a drainage course using granular material as defined in part 2 of this specification.

C. Place drainage course on subgrades free of mud, frost, snow, or ice.

D. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
   1. Place drainage course 6 inches or less in compacted thickness in a single layer.
   2. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   3. Compact each layer of drainage course to a minimum relative density of 75 percent as per ASTM D4253.

3.19 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
   2. Determine that fill material and maximum lift thickness comply with requirements.
   3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

C. Provide inspections and test in accordance with Chapter 17 of the International Building Code.

D. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

E. Testing agency will test compaction of soils in place according to ASTM D 1557, ASTM D 2167, ASTM D 2922, ASTM D 2937 and ASTM D 698, as applicable. Tests will be performed at the following locations and frequencies:
   1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
   2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 200 feet or less of wall length, but no fewer than 2 tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 400 feet or less of trench length, but no fewer than 2 tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

G. Testing agency shall verify materials below shallow foundations are adequate to achieve the design bearing capacity.

3.20 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Architect (or Engineer); reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off of Owner's property.

END OF SECTION

SECTION 31 3116 - TERMITE CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Chemical soil treatment.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Vapor barrier placement under concrete slab-on-grade.

1.03 REFERENCE STANDARDS

A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 1947 (Revised 2001).

1.04 SUBMITTALS

A. See Section 01 3000 - Submittal Procedures.

B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.

C. Test Reports: Indicate regulatory agency approval reports when required.

D. Manufacturer's Certificate: Certify that toxicants meet or exceed specified requirements.

E. Certificate of compliance from authority having jurisdiction indicating approval of toxicants.

F. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing this type of work and:
   1. Having minimum of three (3) years documented experience.
   2. Approved by manufacturer of treatment materials.
   3. Licensed in the State in which the Project is located.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year installer's warranty against damage to building caused by termites.

PART 2 PRODUCTS

2.01 CHEMICAL SOIL TREATMENT

A. Toxicant Chemical: EPA (Title 7, United States Code, 136 through 136y) approved; synthetically color dyed to permit visual identification of treated soil.

B. Manufacturers:
   1. Bayer Environmental Science Corp: www.backedbybayer.com/pest-management.
   2. FMC Professional Solutions: www.fmcprosolutions.com.
   3. Syngenta Professional Products: www.syngentaprofessionalproducts.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

C. Toxicant Chemical: EPA (1) approved; synthetically color dyed to permit visual identification of treated soil.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.

B. Verify final grading is complete.

3.02 APPLICATION - CHEMICAL TREATMENT

A. Comply with requirements of U.S. EPA and applicable state and local codes.

B. Spray apply toxicant in accordance with manufacturer's instructions.

C. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.

D. Re-treat disturbed treated soil with same toxicant as original treatment.

E. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.03 PROTECTION

A. Do not permit soil grading over treated work.

END OF SECTION

SECTION 32 3113 - CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Posts, rails, and frames.

B. Wire fabric.

C. Manual gates with related hardware.

D. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete anchorage for posts.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

B. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2014a.

C. CLFMI CLF-SFR0111 - Security Fencing Recommendations; 2014.

D. FS RR-F-191/1D - Fencing, Wire and Post Metal (Chain-Link Fence Fabric); 1990.

1.04 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures, for submittal process.

B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. See CLFMI CLF-SFR0111 for planning and design recommendations.

D. Samples: Submit two samples of fence fabric, slat infill, ____ inch (____ mm) by ____ inch (____ mm) in size illustrating construction and colored finish.

E. Manufacturer's Installation Instructions: Indicate installation requirements and anchor bolt templates.

F. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines _____.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Line Posts: 1.9 inch (48 mm) diameter.

B. Corner and Terminal Posts: 2.38 inch (60 mm) diameter.

C. Gate Posts: 3-1/2 inch (89 mm) diameter.

D. Fabric: 2 inch (51 mm) diamond mesh interwoven wire, 6 gauge, 0.1920 inch (4.9 mm) thick, top selvage knuckle end closed, bottom selvage twisted tight.

E. Tension Wire: 6 gauge, 0.1920 inch (4.9 mm) thick steel, single strand.

F. Tie Wire: Aluminum alloy steel wire.

2.02 MATERIALS

A. Posts, Rails, and Frames: Formed from hot-dipped galvanized steel sheet, ASTM A653/A653M, HSLAS, Grade 50, with G90 (Z275) zinc coating:

B. Line Posts: Type I round in accordance with FS RR-F-191/1D.

C. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.

D. Wire Fabric: ASTM A392 zinc coated steel chain link fabric:

E. Concrete: Type as specified in Section 03 3000.

2.03 COMPONENTS

A. Fence Height: 7'-0" high

B. Line Posts: 2-1/2 inch (____ mm) diameter.

C. Corner and Terminal Posts: 2.38 inch (60 mm) diameter.

D. Gate Posts: 3.5 inch (89 mm) diameter.

E. Top and Brace Rail: 1.625 inch (____ mm) diameter, plain end, sleeve coupled.

F. Gate Frame: 1.66 inch (42 mm) diameter for welded fabrication.

G. Fabric: 2 inch (51 mm) diamond mesh interwoven wire, 6 gage, 0.1620 inch (4.12 mm) thick, top selvage knuckle end closed, bottom selvage twisted tight.

H. Tension Band: 3/4 inch (____ mm) thick steel.

2.04 MANUAL GATES AND RELATED HARDWARE

A. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches (1,525 mm) high, 3 for taller gates; Provide Panic Egress Hardware on single-leaf gates marked as "Egress" in the Drawings. Provide locking hardware on all gates for outside entry.; keeper to hold gate in fully open position.

B. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches (1,525 mm) high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.
   1. Provide cane bolt on inactive leaf.
   2. Provide wheeled supports at leading edges of double gate leafs.

C. Hinges: Finished to match fence components.
   1. Brackets: Square.
   2. Mounting: Center.
   3. Closing: Self.

2.05 ACCESSORIES

A. Caps: Galvanized pressed steel, malleable iron, or aluminum alloy weather tight closure cap for tubular posts; sized to post diameter, set screw retainer.

B. Provide keyed cylinder lock on gate to generator enclosure. Refer to Door Hardware for product information.

C. Privacy Slats: Pre-finished galvanized steel strips and locking channels, sized to fit fabric weave and full height of fence.
   1. Color: Black
   2. UV Stable.

D. Privacy Slats: High Density Polyethylene (HDPE) strips and locking channels, sized to fit fabric weave and full height of fence.
   1. Color: As selected by Architect from Manufacturer's full range

2.06 FINISHES

A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot (530 g/sq m).

B. Accessories and Hardware: Same finish as framing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the work.
   1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Stake locations of fence lines, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.03 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment as indicated on Drawings.

C. Line Posts: Space line posts uniformly at 96 inches o.c.

D. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
   1. Locate horizontal braces at midheight of fabric 72 inches (1830 mm) or higher, on fences with top rail and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

E. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- (3.05-mm-) diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches (610 mm) o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
   1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches (152 mm) of bottom of fabric and tie to each post with not less than same diameter and type of wire.

F. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

G. Intermediate and Bottom Rails: Install and secure to posts with fittings.

H. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches (50 mm) between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches (380 mm) o.c.

J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach

other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches (300 mm) o.c. and to braces at 24 inches (610 mm) o.c.

K. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.

L. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.

3.04 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install, ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.05 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm).

B. Maximum Offset From True Position: 1 inch (25 mm).

C. Do not infringe on adjacent property lines.

3.06 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION

Subsurface Exploration and Geotechnical Engineering Report

Proposed Specialty Surgical Hospital Project
Baton Rouge, Louisiana
Premier File No.: 23-0086

Prepared for:

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Appendix: Test Location Plan Sheet
Key to Logs Sheet
Log of Boring Sheets

INTRODUCTION

Premier Geotech and Testing, LLC (Premier) is pleased to present this Subsurface Exploration and Geotechnical Engineering Report for the proposed Specialty Surgical Hospital project to be located in Baton Rouge, Louisiana. Our services were performed in general accordance with the executed agreement between Premier and Stumberg Medical, LLC, signed by Michael Divicinti on March 1, 2023.

PROJECT AND SITE DESCRIPTION

The proposed project consists of the design and construction of a specialty surgical hospital with its associated retention ponds, parking areas, and driveways. The proposed hospital will be a single-story building with an approximate footprint area of about 41,000 square feet. Reportedly, a future 3,900 square feet expansion is anticipated at the east side of the building. The building will have traditional steel beam and column framing lines supporting steel open web roof joists with a light gage metal deck. The exterior walls will be cold formed, metal stud framing and window glazing systems, with a brick veneer and metal panel façade. The proposed project site is located just southeast of the intersection of Jefferson Highway and Stumberg Lane in Baton Rouge, Louisiana. At the time of our field exploration, the site was an empty grass field with concrete roads running through.

Premier drilled and sampled thirty-six (36) soil borings to depths ranging from about six (6) to forty-five (45) feet below existing site grades. The borings were sampled continuously to a depth of about ten (10) feet and on 5-foot centers thereafter.

The following table lists the structural loads and other features that are required for or are the design basis for the recommendations on this report:

STRUCTURAL LOAD/PROPERTY	REQUIREMENT/REPORT BASIS		
1-STORY BUILDING		**R[1]**	**B[2]**
Maximum Column Load	45 kips downward (D + L)	☒	☐
Maximum Sustained Column Load	20 kips (Dead)	☒	☐
Maximum Column Net Uplift	25 kips (0.6Dead + 0.6Wind)	☒	☐
Maximum Sustained Wall Load	2000 lbs/ft (Dead)	☒	☐
Maximum Floor Loads	144 psf	☐	☒
Settlement Tolerances	About one (1) inch	☐	☒
GRADING			
Anticipated Amount of Fill Material Required to Achieve Design Grade	Less than two (2) feet	☐	☒

Notes:

1. R = Requirement indicates specific design information was supplied.
2. B = Report Basis indicates specific design information was not supplied; therefore, this report is based on this parameter assumption.

The geotechnical recommendations presented in this report are based on the available project information at the time of this report and the subsurface materials information obtained from the subsurface exploration performed for the project as described herein. If any of the information included in this report is incorrect, please inform Premier in writing so that we amend the recommendations presented in this report if appropriate and if desired by the Client. Premier will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

SITE CONDITIONS

Subsurface Conditions

The encountered subsurface soils generally consist of very soft to hard alternating layers of lean and fat clays from existing site grades to a depth of about forty-five (45) feet, the maximum depth explored. In addition, the concrete pavement of the existing roads on site measured about six (6) to seven (7) inches thick (borings P-3, P-7, P-8, P-9, P-13, P-14, P-15).

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in the Appendix should be reviewed for specific information at individual boring locations. These records include soil descriptions, stratifications, penetration resistances, samples' locations, and laboratory test data. The stratifications shown on the boring logs are approximate and represent the conditions at the actual boring locations only. Variations may occur and should be expected between test locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained (if any) during field operations is also shown on the boring logs. Samples not altered by laboratory testing will be retained for a period of thirty (30) days from the date on this report and then will be discarded.

Seismic Classification

As requested, we classified the site in accordance with the 2021 International Building Code (IBC). Based on the soil properties encountered at the site, the project site should be classified as Seismic Site Classification D. This classification was based on the results of our field exploration, laboratory testing program and our experience in the area. Design of the foundations for the facility should consider this site classification.

Groundwater Conditions

Free groundwater was encountered at a depth of about ten (10) feet below existing site grades at the time of our field exploration. Once groundwater was encountered, drilling was halted for a period of about fifteen (15) minutes and the groundwater level was measured again. After fifteen (15) minutes, the groundwater level rose to a depth of about eight (8) feet. It should be noted that groundwater level fluctuations may occur due to seasonal and climatic variations, alteration of drainage patterns, land usage, and ground cover, and could affect excavation activities. We recommend the Contractor determine the actual groundwater levels at the time construction activities begin.

Presence of Expansive Soils

Field and laboratory test results indicate that the soils encountered at the site exhibit a high shrink and swell potential. **A Potential Vertical Rise (PVR) value of about 3.0 inches was calculated using the TEX-124E method with an applied contact pressure of 144 psf and assuming an active zone of eight (8) feet.**

The estimated amount of vertical movement of a foundation or floor slab constructed on swelling clays is referred to as the Potential Vertical Rise (PVR). To reduce the potential for shrinkage and swelling of the site soils, it is important that consideration be given to reducing the potential for moisture changes of the site soils. As a minimum, positive drainage away from the new buildings should be provided. If positive drainage is not provided, water will pond around and/or below the structure and total and differential movements higher than the indicated in this report may occur.

SUITABILITY OF ON-SITE SOIL AS FILL MATERIAL

Borings D-1 through D-6 were drilled and sampled within the footprint of the proposed stormwater detention areas. The subsurface soils encountered in these borings generally consist of alternating layers of lean and fat clays from existing site grades to the borings' completion depth at about fifteen (15) feet.

Based on the laboratory test results, the lean clay materials encountered from a depth of about two (2) to eight (8) feet in boring D-2 had Liquid Limits (LL) and Plasticity Indices (PI) that are typically acceptable to be used as structural fill material (LL<40 and 12<PI<22). The other lean clay and fat clay materials encountered do not comply with the LL and PI specifications for structural fill. Therefore, lime treatment of these materials shall be anticipated prior to being used as structural fill. The exact percentage of lime is not known at this time; however, Premier can perform a lime series to determine the best percentage upon request.

FOUNDATION RECOMMENDATIONS

Our building foundation recommendations are presented in the following sections. We considered the subsurface soil conditions encountered in the soil borings performed for the project, as well as our experience with similar soil conditions and the provided/assumed design requirements to develop the recommendations discussed herein.

Based on the information obtained from the soil borings, laboratory test results and provided/assumed design data, Premier determined a shallow foundation system is suitable to support the proposed structure. Due to the high shrink/swell potential of the subsurface soils encountered, the use of a stiffened and reinforced post-tensioned BRAB Type III slab is recommended.

Post-Tensioned Slab-on-Grade and Grade Beam System

The proposed new structure will be a single-story building to be supported on a post-tensioned slab-on-grade system. The following recommendations are based on the Post Tension Institute

(PTI) method. It is recommended that the grading activities be such that the fill thickness be uniform across the plan footprint area of the building. Any fill should extend at least five feet beyond the perimeter of the building.

Design parameters are given below for the condition when a post-tensioned slab-on-grade is to be placed on a thin layer of select structural fill or natural soil. The differential movements given below should be taken into account by the Structural Engineer for the foundation design:

Predominant Clay Type	Montmorillonite
Average Plasticity Index, PI	Approx. 42
Average Unconfined Compressive Strength q_u, psf	2,700
Thornthwaite Moisture Index	38
Edge Moisture Variation Distance, e_m	
Edge Lift, ft	5.1
Center Lift, ft.	9.0
Depth to Constant Soil Suction, ft.	9.0
Constant Soil Suction, pF	3.2
Soil Differential Movement, Y_m	
Edge Lift, in.	1.52
Center Lift, in.	1.47

It should be realized that the soil differential movements presented above do not account for the influence of vegetation, such as trees and shrubs located near the foundation, which can greatly influence the foundation performance. Also, the construction of post-tensioned slabs requires close attention to detail during construction. Only contractors experienced in post-tensioned slab construction should be used on this project.

Grade beams should be placed at least 18 inches below the finished grade on properly compacted structural fill material or stiff in-situ clay soil. Foundations placed at least 18 inches below finished grade can be designed for a net allowable bearing pressure of 1,000 psf.

The foundation excavations should be observed by a representative of Premier prior to steel or concrete placement in order to assess the condition of the foundation materials is consistent with the materials discussed in this report. Soft or loose soil zones encountered at the bottom of the footing excavations should be removed and replaced with properly compacted structural fill as directed by the Geotechnical Engineer.

After opening and observation of foundation excavations, concrete should be placed as quickly as possible to avoid exposure of the foundations bottom to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. The foundation concrete should be placed during the same day the excavation is made. If it is required that foundation excavations be left open for more than one day, they should be protected to reduce

evaporation or entry of moisture.

Estimated Settlement

We estimated the settlement behavior of shallow foundations based on the results of our laboratory testing and our experience with similar soil conditions. Settlement was estimated based on total sustained dead loads of 70% of the above recommended net allowable bearing pressure plus up to two (2) feet of fill material, using empirical correlations between Atterberg Limits and compressibility. A detailed settlement analyses was beyond the scope of our services.

Total settlement of continuous footings up to two (2) feet in width and placement of up to two (2) feet of fill material in accordance with the recommendations presented herein, are expected to be about 1.8 inches. However, we anticipate about 25 to 30 percent of the estimated settlement to occur during construction. Therefore, post construction settlement is anticipated to be about 1.25 inches. All things being equal, differential settlements are expected to be about half of the total settlements.

Uplift Resistance

The uplift resistance of shallow spread footings formed in open excavations should be limited to the weight of the foundation concrete and the soil above it. For preliminary design purposes, the uplift resistance can be computed by using a total unit weight of 118 pcf for the structural fill placed and compacted above the footing and a unit weight of 150 pcf for the concrete. Concrete reinforcing steel should be properly sized to resist uplift forces. We recommend that a factor of safety of at least 1.5 be used when determining the allowable uplift resistance of spread footings.

The resistance to sliding of spread footings bearing in structural fill can be computed by multiplying the footing base contact area by a sliding friction factor of 0.35. Spread footings should be sized to resist overturning due to moment forces.

Floor Slab

The floor slab can be grade supported on naturally occurring clay, or a minimum of 12 inches of properly compacted structural fill material. Premier recommends that a minimum four (4) inch thick free-draining granular mat be placed beneath the floor slab to enhance drainage. The soil surface shall be graded to drain away from the building without low spots that can trap water prior to placing the granular drainage layer. Proof-rolling, as discussed in this report, should be accomplished to identify soft or unstable soils that should be removed from the floor slab area prior to fill placement and/or floor slab construction. These soils should be replaced with properly compacted structural fill as described in this report.

The precautions listed below should be followed for construction of slab-on-grade pads. These details may not reduce the amount of soil movement but are intended to reduce potential damage should some settlement of the supporting subgrade take place. Some increase in moisture content

is inevitable as a result of site development and associated landscaping. However, extreme moisture content increases can be largely controlled by proper and responsible site drainage, building maintenance and irrigation practices.

- Cracking of slab-on-grade concrete is normal and should be expected. Cracking can occur not only as a result of heaving or compression of the supporting soil, but also as a result of concrete curing stresses. The occurrence of concrete shrinkage crack, and problems associated with concrete curing may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement, finishing, and curing, and by the placement of crack control joints at frequent intervals, particularly where re-entrant slab corners occur. The American Concrete Institute (ACI) recommends a maximum panel size (in feet) equal to approximately three times the thickness of the slab (in inches) in both directions. For example, joints are recommended at a maximum spacing of twelve (12) feet based on having a four-inch slab. Premier also recommends that the slab be independent of the foundation walls. Using fiber reinforcement in the concrete can also control shrinkage cracking.
- Areas supporting slabs should be properly moisture conditioned and compacted. Backfill in all interior and exterior water and sewer line trenches should be carefully compacted to reduce the shear stress in the concrete extending over these areas.
- Exterior slabs should be isolated from the building. These slabs should be reinforced to function as independent units. Movement of these slabs should not be transmitted to the building foundation or superstructure.

Moisture Control

Polyethylene sheeting should be placed to act as a vapor retarder where the floor will be in contact with moisture sensitive equipment or products sch as tile, wood, carpet, etc., as directed by the Design Engineer. The decision to locate and/or place the vapor retarder in direct contact with the slab or beneath the layer of granular fill should be made by the design engineer after considering the moisture sensitivity of subsequent floor finishes, anticipated project conditions, and the potential effects of slab curling and cracking.

PAVEMENT RECOMMENDATIONS

Pavement Sections

Actual anticipated traffic type and frequency was not known at the time of this report. However, Premier assumed that the average daily traffic (ADT) will consist of mostly passenger vehicles with occasional truck traffic (i.e. delivery truck, garbage truck, etc.). Premier assumed pavement-related design parameters that are considered typical for the existing soil types at the project site.

Specific design parameters considered in the pavement design are as follows:

Design Life	15 Years
CBR	3
Modulus of Subgrade Reactions, k	115 pci
Reliability	85%
Deviation	0.47 Flexible; 0.35 Rigid
Initial Serviceability	4.2
Terminal Serviceability	2.0
Drainage Coefficient	1.0 Pavement; 0.9 Base

With the aforementioned parameters, it is possible to use a typical “standard” pavement section consisting of the following:

USAGE	RIGID PAVEMENT (Concrete)	FLEXIBLE PAVEMENT (Asphalt)
Pedestrian Vehicle Drives/Parking	5 inches of concrete over *10 inches lime stabilized base over proof rolled stable subgrade	3 inches of asphalt over *12 inches of cement stabilized base over proof rolled stable subgrade
Truck Drives/ Parking/Dumpster Location(s)	8 inches of concrete over *12 inches lime stabilized base over proof rolled stable subgrade	5 inches of asphalt over 6 inches of compacted aggregate base over *12 inches of cement stabilized subbase over proof rolled stable subgrade
* See *Base and Sub-Base Recommendations* section below		

The pavement subgrade, subbase, base and pavement shall be prepared in accordance with the latest edition of the Louisiana Standard Specifications for Road and Bridges (LSSRB) and the recommendations provided in this report. The recommended pavement thicknesses presented below are considered typical and minimum for the assumed parameters for this site. We understand that budgetary considerations sometimes warrant thinner pavement sections than those presented herein. However, the Client, the Owner, and the Project Designers should be aware that thinner pavement/base sections may result in increased maintenance costs and lower than anticipated pavement life.

The use of recycled crushed concrete is an approved aggregate base alternative to crushed stone. The aggregate base shall meet the requirements of the latest edition of the LSSRB, Sections 1003.3.3.1 and 1003.3.2.

The base and subbase course shall be compacted to at least 95 percent of its maximum dry

density near the optimum moisture content in accordance with ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

Pavement materials may be placed after the subgrade or structural fill has been properly proof rolled or compacted, and fine-graded. These activities shall be accomplished following the LSSRB construction guidelines.

Proper finishing of concrete pavement requires the use of appropriate construction joints to reduce cracking. Construction joints shall be designed in accordance with the current Portland Cement Association and the American Concrete Institute guidelines. Joints should be sealed to reduce the potential for water infiltration into the supporting soils. The design of steel reinforcement should be in accordance with current accepted codes.

Asphaltic concrete should meet the requirements of Part V of the latest edition of the LSSRB. The aggregate base should meet the requirements of Sub-Section 1003.03.1 or 1003.03.2 of the LSSRB. The base and structural fill should be compacted to at least 95 percent of the maximum dry density near the optimum moisture content in accordance with ASTM D698.

Water should not be allowed to pond behind curbs and saturate the base. In down grade areas, the granular base shall extend through the slope to provide an exit path for any water accumulating under the pavement.

It should be noted that although a cement treated base may be adequate to support the anticipated traffic loads, some reflective cracking should be anticipated in the new pavement as a result of shrinkage cracks that may develop in the cement treated base prior to asphalt placement. The use of three (3) to four (4) inches of stone (meeting the requirements of LSSRB) at the cement treated base and asphalt interface will help reduce reflective cracking and extend the life of the pavement.

*Base and Sub-Base Recommendations

Cement Stabilized Material

For cement stabilization, a minimum of 8% by volume of cement is recommended for preliminary consideration. Laboratory tests should be conducted on soil samples that are being considered for treatment at the time of or prior to construction to determine the optimum cement content. Cement treatment shall meet the requirements of Section 303 of the latest edition of the LSSRB. The cement treated base course shall yield a compressive strength of at least 300 psi at 7 days as determined by a mix design in accordance with DOTD TR 432 Standard Procedure.

Lime conditioning is required prior to cement treatment in accordance with Section 304 for Type C treatment if the PI (Plasticity Index) of the untreated soil is greater than 22. The percentage lime by volume required for lime conditioning is 6% when the PI of the soil is between 22 and 25, and 8% when the PI of the soil is between 26 and 35. The treated soil shall be compacted at least 95% of its maximum dry density near the optimum moisture content in accordance with Sub-Section 303.11 of the latest edition of LSSRB.

Lime Stabilized Material

For lime stabilization, approximately 8 percent lime by volume will likely be required to stabilize a low to moderate plasticity clay fill soil (PI between 15 and 25) and approximately 10 percent lime by volume may be required to stabilize a moderate to high plasticity clay soil (PI between 26 and 35). If the PI of the material to be stabilized is below 14, cement should be used in lieu of lime. Laboratory tests should be conducted on bulk soil samples that are being considered for treatment at the time of construction, or prior to, to determine the optimum lime content.

Lime treatment should meet the requirements of Section 304 and Type C treatment of the latest edition of the LSSRB. The lime treated soil shall have a maximum liquid limit of 40, a maximum PI of 22 and should be compacted at least 95 percent of maximum dry density near the optimum moisture content as determined by ASTM D698.

The moisture content of the stabilized soil should be monitored throughout the curing process and moisture should be added as needed to ensure proper hydration and stabilization. Lime stabilized clay should be placed in horizontal loose lifts not exceeding 8 inches in thickness, or less if necessary, to obtain adequate compaction. Each lift should be thoroughly and uniformly moisture-conditioned to within +1 to +3 percent of the optimum moisture content.

Crushed Stone/Recycled Concrete Aggregate Material

Properly graded crushed stone or recycled crushed concrete meeting the requirements of Section 1003.03.1 and 1003.03.2 of the LSSRB should be utilized beneath the pavements where specified in the *Recommended Pavement Sections* table presented in this report. The aggregate base material should be placed in accordance with LADOTD Section 302 and compacted to at least 95 percent of the maximum dry density as determined by ASTM D698 using a smooth pad roller. Placement and compaction of the aggregate material should be near optimum moisture.

Please note that caution should be used when cement and/or lime treatment is performed on sites in closely populated areas.

EARTHWORK RECOMMENDATIONS

Site Preparation

Premier recommends that all existing slabs, pavements, topsoil, stumps, vegetation, roots, soft, organic, or unsuitable soils in the construction areas be stripped in its entirety from the site and either wasted or stockpiled for later use in non-structural areas. After stripping operations are completed, and prior to any fill placement, proof rolling of the subgrade is required as discussed later in this report. It should also be noted that it is not unusual for topsoil thickness to vary from the values stated in this report in the open field. Oftentimes, topsoil can be deeper in low-lying areas, where erosion, wind and precipitation can deposit this material. For estimating purposes, Premier anticipates an average stripping depth of approximately 6- to 8-inches, but this shall be verified by the Contractor(s) prior to bidding and construction. There may be areas of the site that require additional, or possibly less stripping for the reasons discussed above. A representative of Premier should determine and document the depth of removal at the time of construction.

The in-situ clays encountered at this project site will undergo a significant loss of stability when construction activities are performed during wetter portions of the year. Premier anticipates that the soils in the project area can become easily disturbed if subjected to conventional rubber tire or narrow track-type equipment and excessive moisture. Soils that become disturbed would need to be excavated and replaced; however, this remedial excavation may expose progressively wetter soils with depth, thus compounding the problem condition. Thus, a normal approach to subgrade preparation may not be possible. Appropriate wide-track equipment selection should aid in minimizing potential disturbance. In addition, and for these reasons, it will be advantageous to perform earthwork and foundation construction activities during dry weather.

Proof Rolling

After stripping to the proposed subgrade level as required, the building areas should be proof-rolled with a 20-25-ton, half-loaded tandem axle dump truck or similar heavy rubber-tired vehicle (typically with an axial load greater than nine (9) tons) and observed by a representative from Premier. Soils that are observed to rut or deflect greater than one (1) inch under the moving load should be undercut and replaced with properly compacted structural fill material or rendered stable by using a combination of lime/ fly ash/ kiln dust. The proof-rolling and undercutting activities should be witnessed by a representative of Premier and should be performed during a period of dry weather. Care should be taken during construction activities not to allow excessive drying or wetting of exposed soils. The subgrade soils should be scarified and compacted to at least 95% of the materials' Standard Proctor maximum dry density, in general accordance with ASTM procedures, to a depth of at least twelve (12) inches below existing subgrade.

Surficial fat clays are anticipated to be encountered while achieving compaction or passing a proof-roll. Therefore, replacing this material with a low plasticity compacted soil or a dense positively drained graded crushed stone/concrete should be anticipated. Alternatively, Class "C" fly ash or

lime-treatment of the high plastic clay can be accomplished to reduce the plasticity index, improve workability, promote drying, and reduce shrink/swell potential. A representative of Premier's Geotechnical Engineer should observe the subgrade soils, perform plasticity index tests, and estimate the approximate extent of the exposed fat clays. If it is desirable to modify the fat clays with a commercially available Class "C" fly ash or lime product, Premier recommends the actual application percent be determined by conducting a laboratory Class "C" fly ash or lime series test. The Geotechnical Engineer's representative should observe the remediation procedures for compliance with the project plans and specifications.

Fill Material and Placement

After subgrade preparation and proof-rolling and observation have been completed, fill placement required to obtain finish grade may begin. A representative of Premier should be on-site to observe, test, and document all placement of the fill. If the fill is too dry, water should be uniformly applied and thoroughly mixed into the soil by disking or scarifying. Close moisture content control will be required to achieve the recommended degree of compaction. It should be noted that high plasticity clays are typically more difficult to compact and achieve the optimum moisture content during the placement of fill. The following table details the recommended specifications for fill placement, testing, etc.

Fill Material Testing Specifications

SPECIFICATION	REQUIREMENT
Lift Thickness	Maximum 8-inch loose lifts when compacted with large heavy compaction equipment. Maximum 6-inch loose lifts when compacted with lightweight compaction equipment (thinner lifts may be required in confined locations).
Density	Minimum of 95 percent of maximum dry density as defined by ASTM D 698 at all locations and depths.
Moisture	± 2 percent of optimum moisture as defined by ASTM D 698 for cohesive soils. For cohesionless soils with greater than 12 percent passing the US Standard No. 200 sieve, ± 3 percent of optimum moisture as defined above. Moisture requirement is waived for cohesionless soils with less than 12 percent passing the No. 200 sieve.
Density Testing Frequency	One test per 2,500 sf in building areas and one test per 5,000 sf in pavement areas or a minimum of 3 tests per lift in each area. One test per 200 feet of trench backfill with minimum of 2 tests per lift, or as required by local government agencies.

The edges of compacted fill should extend a minimum of five (5) feet beyond the building footprint, or a distance equal to the depth of fill beneath the footings, whichever is greater. The measurement should be taken from the outside edge of the footing to the toe of the excavation prior to sloping.

Structural Clay Fill

Structural clay fill materials placed beneath structural features or slabs should be free of organic or other deleterious materials and have a maximum particle size of less than three (3) inches. Structural clay fill soils are defined as having a liquid limit (LL) less than forty (40) and plasticity index (PI) between twelve (12) and twenty-two (22) and plots below the A-line on the plasticity chart, or as approved by the Geotechnical Engineer of Record.

Utility Trench Backfill

Excavation for utility trenches shall be performed in accordance with OSHA regulations as stated in 29 CFR Part 1926. It should be noted that utility trench excavations have the potential to degrade the properties of adjacent fill materials. Utility trench walls that are allowed to move laterally can lead to reduced bearing capacity and increased settlement of adjacent structural elements and overlying slabs.

Backfill for utility trenches is as important as the original subgrade preparation or structural fill placed to support either a foundation or slab. Therefore, it is imperative that the backfill for utility trenches be placed to meet the project specifications for the structural fill for this project. Premier recommends that flowable fill or lean mix concrete be utilized for utility trench backfill. If on-site soils are placed as trench backfill, the backfill for the utility trenches should be placed in four (4) to six (6) inch loose lifts and compacted to a minimum of 95% of the maximum dry density achieved by the Standard Proctor test. The backfill soil should be moisture conditioned to be within 2% of the optimum moisture content as determined by the Standard Proctor test. Up to four (4) inches of bedding material placed directly under the pipes or conduits placed in the utility trench can be compacted to the 90% compaction criteria with respect to the Standard Proctor. Backfill of utility trenches should not be performed with water standing in the trench. If granular material is used for the backfill of the utility trench, the granular material should have a gradation that will filter protect the backfill material from the adjacent soils. If this gradation is not available, a geosynthetic non-woven filter fabric should be used to reduce the potential for the migration of fines into the backfill material. Granular backfill material shall be compacted to meet the above compaction criteria. The clean granular backfill material should be compacted to achieve a relative density greater than 75% or as specified by the Geotechnical Engineer for the specific material used.

Excavations

In Federal Register, Volume 54, Number 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better enhance the safety of workers entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new OSHA guidelines. It is Premier's

understanding that these regulations are being strictly enforced and if they are not closely followed, the Owner and the Contractor could be liable for substantial penalties.

The Contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The Contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the Contractor's safety procedures. In no case should slope height, slope inclination or excavation depth, including utility trench excavation depth, exceed those specified in local, state and federal safety regulations. Premier is providing this information solely as a service to our Client. Premier does not and will not assume responsibility for construction site safety or the Contractor's or other parties' compliance with local, state and federal safety or other regulations.

REPORT LIMITATIONS

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which Geotechnical Engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned. The engineering recommendations presented in the preceding sections constitute Premier's professional estimate of those measures that are necessary for the proposed structure(s) to perform according to the proposed design based on the information generated and referenced during this evaluation, and Premier's experience in working with those conditions.

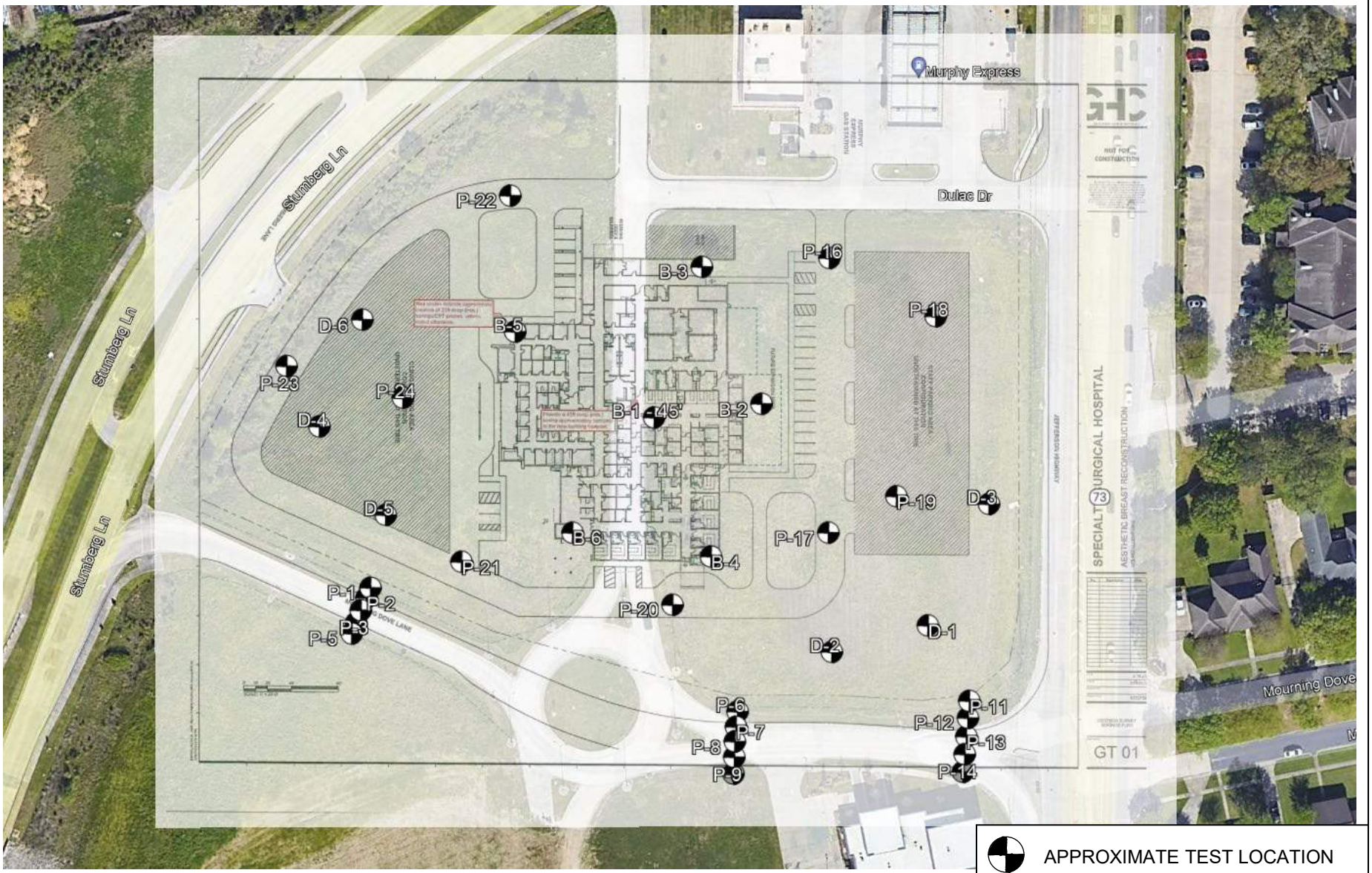
The recommendations submitted in this report are based on furnished project information by the design team and the subsurface information obtained from borings drilled by Premier. If there are any revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, Premier must be notified immediately to determine if changes in the foundation recommendations are required. If Premier is not notified in writing of such changes, Premier will not be responsible for the impact of those changes on the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are complete, the Geotechnical Engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our geotechnical engineering recommendations have been properly incorporated into the design documents.

The scope of Premier's services did not include any environmental assessment or investigation for the presence or absence or hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied. Any statements in this report regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of our Client.

This report and the information/data provided have been prepared for the exclusive use of Stumberg Medical, LLC and their design team for the specific application to the proposed Specialty Surgical Hospital project to be located in Baton Rouge, Louisiana. The information and data obtained and prepared (i.e., Instrument of Service) by Premier Geotech and Testing, LLC may not be used or relied on by any other entity, now or at any point in the future, without the express, written consent from Premier Geotech and Testing, LLC.



N

PROPOSED SPECIALTY SURGICAL HOSPITAL
BATON ROUGE, LOUISIANA
PREMIER FILE NO.: 23-0086

Premier GEOTECH AND TESTING, LLC

TEST LOCATION PLAN

APPROXIMATE TEST LOCATION

N

PROPOSED SPECIALTY SURGICAL HOSPITAL
BATON ROUGE, LOUISIANA
PREMIER FILE NO.: 23-0086

Premier GEOTECH AND TESTING, LLC

TEST LOCATION PLAN 2

KEY TO SYMBOLS

Symbol Description

Strata symbols

High plasticity clay

Low plasticity clay

Fill

Paving

Misc. Symbols

Water table during drilling

Water table at boring completion

■ **Unconfined Shear Strength**

Soil Samplers

Undisturbed thin wall Shelby tube

Notes:

1. **Boring locations were located using handheld GPS technology.**

2. **These logs are subject to the limitations, conclusions, and recommendations in this report.**

3. **Results of tests conducted on samples recovered are reported on the logs.**

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'32.04"N 91° 2'17.16"W

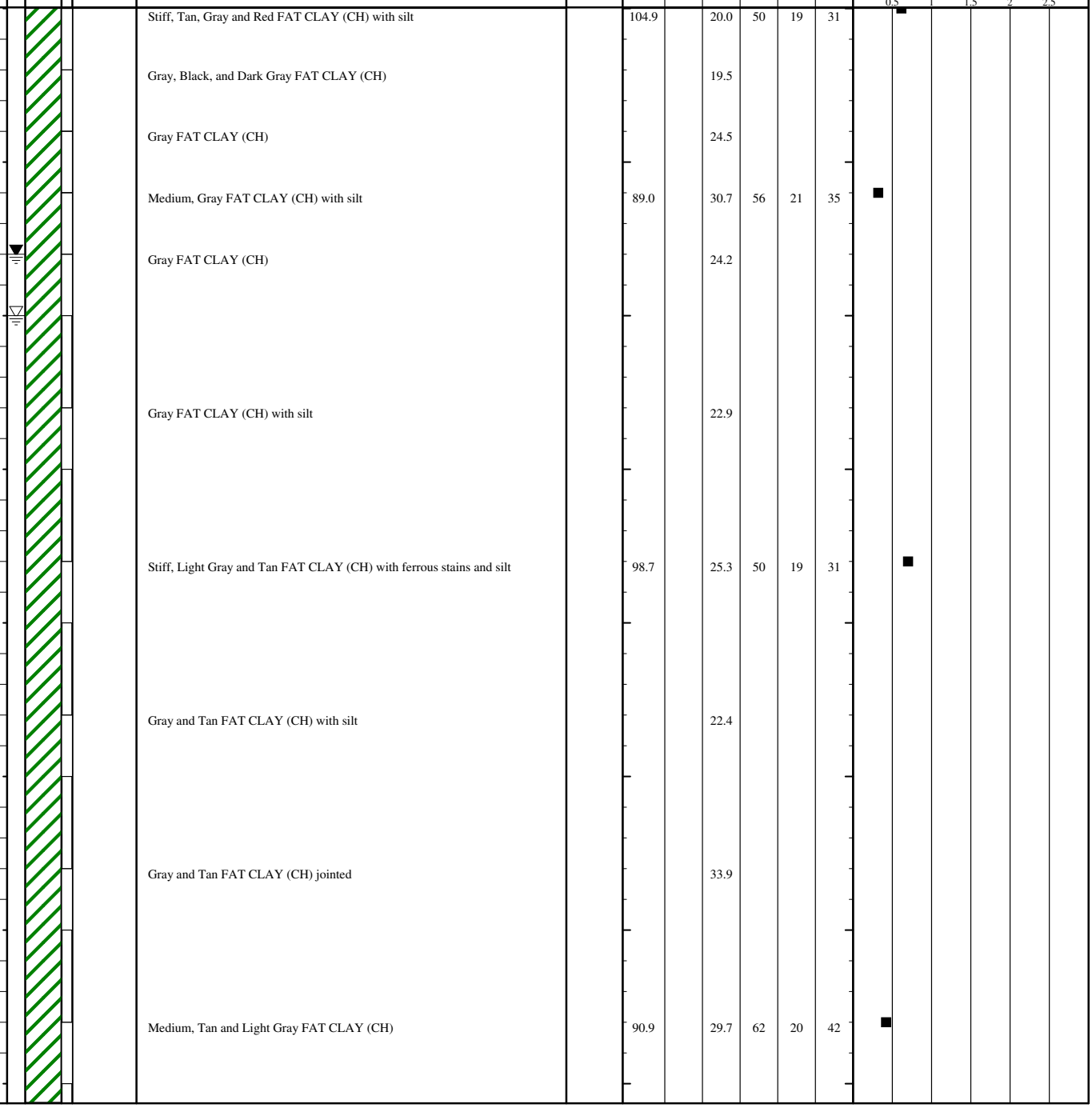
SURFACE EL.: EXISTING GRADE

DEPTH, FT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0	Stiff, Tan, Gray and Red FAT CLAY (CH) with silt		104.9		20.0	50	19	31
	Gray, Black, and Dark Gray FAT CLAY (CH)				19.5			
	Gray FAT CLAY (CH)				24.5			
5	Medium, Gray FAT CLAY (CH) with silt		89.0		30.7	56	21	35
	Gray FAT CLAY (CH)				24.2			
10								
	Gray FAT CLAY (CH) with silt				22.9			
15								
	Stiff, Light Gray and Tan FAT CLAY (CH) with ferrous stains and silt		98.7		25.3	50	19	31
20								
	Gray and Tan FAT CLAY (CH) with silt				22.4			
25								
	Gray and Tan FAT CLAY (CH) jointed				33.9			
30								
	Medium, Tan and Light Gray FAT CLAY (CH)		90.9		29.7	62	20	42
35								

SHEAR STRENGTH

Penetrometer ■ Unconfined
Torvane ◇ ● Triaxial
Field Vane △ ▲ Miniature Vane

TONS PER SQ FT
0.5 1 1.5 2 2.5



NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 45
WATER LEVEL: 10'
BACKFILL: CEMENT-BENTONITE GROUT

LOG OF BORING B-1
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'32.04"N 91° 2'17.16"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH
40					Tan and Gray FAT CLAY (CH) brittle				29.3				
45					Tan and Gray FAT CLAY (CH) jointed				39.8				
					Boring Terminated at 45 Feet	45.0							
50													
55													
60													
65													
70													

SHEAR STRENGTH: □ Penetrometer ■ Unconfined ◇ Torvane ● Triaxial △ Field Vane ▲ Miniature Vane
TONS PER SQ FT: 0.5 1 1.5 2 2.5

NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 45
WATER LEVEL: 10'
BACKFILL: CEMENT-BENTONITE GROUT

LOG OF BORING B-1
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'32.89"N 91° 2'16.93"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0					Gray and Tan FAT CLAY (CH) with silt pockets				20.2			
					Medium, Tan and Light Gray FAT CLAY (CH) with silt		96.9		26.0	57	15	42
					Gray LEAN CLAY (CL)	4.0			23.5			
5					Gray LEAN CLAY (CL)				30.3			
	▼				Gray LEAN CLAY (CL)				27.2			
10	▽											
					Stiff, Gray FAT CLAY (CH) with silt	13.0	100.4		24.8	56	17	39
15												
					Gray LEAN CLAY (CL)	18.0			25.6			
20												
					Gray and Tan FAT CLAY (CH) with silt	23.0			22.4			
25					Boring Terminated at 25 Feet	25.0						
30												
35												

SHEAR STRENGTH

□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane

TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/20/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 25
WATER LEVEL: 10'
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING B-2
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'32.82"N 91° 2'18.33"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					FILL - Tan and Gray LEAN CLAY (CL) with ferrous nodules				16.0				
					Tan and Light Gray FAT CLAY (CH) with silt	2.0			20.8				
					Medium, Green, Gray and Tan LEAN CLAY (CL)	4.0	94.2		23.5	42	21	21	
5					Light Gray and Tan LEAN CLAY (CL)				25.0				
	▼				Medium, Gray LEAN CLAY (CL)		91.4		30.2	48	20	28	
10	▽												
					Gray LEAN CLAY (CL)				24.0				
15													
					Gray FAT CLAY (CH) with silt	18.0			22.7				
20													
					Stiff, Gray and Tan FAT CLAY (CH) with silt		101.0		23.8	51	18	33	
25					Boring Terminated at 25 Feet	25.0							
30													
35													

SHEAR STRENGTH: TONS PER SQ FT (0.5, 1, 1.5, 2, 2.5)
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane

NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/20/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 25
WATER LEVEL: 10'
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING B-3
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'32.07"N 91° 2'15.75"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)
0					FILL - Stiff, Tan LEAN CLAY (CL) with roots		105.2		18.8	48	20	28
					Gray and Tan FAT CLAY (CH) with silt seams	2.0			18.7	52	19	33
5					Gray and Tan LEAN CLAY (CL)	4.0			22.6			
					Gray LEAN CLAY (CL)				23.9			
	▼				Stiff, Gray FAT CLAY (CH) with silt	8.0	95.3		26.5			
10	▽											
					Gray LEAN CLAY (CL)	13.0			22.4			
15												
					Medium, Light Gray and Tan LEAN CLAY (CL)		99.6		24.1			
20												
					Gray and Tan FAT CLAY (CH) with silt	23.0			21.1			
25					Boring Terminated at 25 Feet	25.0						
30												
35												

SHEAR STRENGTH

□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane

TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/20/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 25
WATER LEVEL: 10'
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING B-4
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'31.22"N 91° 2'18.37"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Dark Gray LEAN CLAY (CL) with roots				21.4				
					Stiff, Dark Gray, Light Gray and Tan FAT CLAY (CH)	2.0	96.2		25.0	69	24	45	
5					Gray and Tan LEAN CLAY (CL)	4.0			21.3				
					Dark Gray and Black LEAN CLAY (CL) with roots and organics				21.9				
	▼				Stiff, Gray FAT CLAY (CH) with silt	8.0	90.8		27.3	53	21	32	
10	▽												
					Gray FAT CLAY (CH)				24.1				
15													
					Gray FAT CLAY (CH)				28.5				
20													
					Hard, Gray FAT CLAY (CH)		101.0		24.2	52	19	33	
25					Boring Terminated at 25 Feet	25.0							
30													
35													

SHEAR STRENGTH: TONS PER SQ FT (0.5, 1, 1.5, 2, 2.5)
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane

NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/22/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 25
WATER LEVEL: 10'
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING B-5
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'31.09"N 91° 2'16.41"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)
0					Stiff, Dark Gray FAT CLAY (CH) with silt		105.5		18.2	54	20	34
					Gray LEAN CLAY (CL)	2.0			25.9			
5					Gray, Dark Gray and Black LEAN CLAY (CL) with organics				25.1			
					Stiff, Gray LEAN CLAY (CL) with organics and roots		94.6		28.6	49	20	29
	▼				Gray FAT CLAY (CH)	8.0			24.9			
10	▽											
					Medium, Gray FAT CLAY (CH) with silt		96.5		26.9	72	23	49
15												
					Gray, Tan and Light Gray LEAN CLAY (CL)	18.0			27.5			
20												
					Gray, Light Gray and Tan LEAN CLAY (CL)				20.2			
25					Boring Terminated at 25 Feet	25.0						
30												
35												

SHEAR STRENGTH

Penetrometer ■ Unconfined
Torvane ● Triaxial
Field Vane ▲ Miniature Vane

TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/22/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 25
WATER LEVEL: 10'
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING B-6
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'33.53"N 91° 2'14.43"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0	Tan, Light Gray and Red LEAN CLAY (CL)				19.8	43	20	23
	Gray and Tan LEAN CLAY (CL)				23.7			
5	Gray LEAN CLAY (CL)				27.1	41	23	18
	Gray LEAN CLAY (CL)				23.9			
	Gray FAT CLAY (CH) with silt	8.0			30.2	53	21	32
10								
	Gray and Tan FAT CLAY (CH) with silt				22.3			
15	Boring Terminated at 15 Feet	15.0						
20								
25								
30								
35								

SHEAR STRENGTH
Penetrometer, Torvane, Field Vane, Unconfined, Triaxial, Miniature Vane
TONS PER SQ FT: 0.5, 1, 1.5, 2, 2.5

NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/20/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 15
WATER LEVEL: 10'
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING D-1
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'32.72"N 91° 2'14.51"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH (TONS PER SQ FT)
0					FILL - Tan, Gray and Light Gray LEAN CLAY (CL) with roots				19.6				
					Gray LEAN CLAY (CL)	2.0			17.4	39	20	19	
5					Gray LEAN CLAY (CL)				23.7				
					Gray LEAN CLAY (CL)				27.6	34	22	12	
10					Gray FAT CLAY (CH) with silt	8.0			23.9				
					Light Gray and Gray FAT CLAY (CH) with silt				25.1	55	20	35	
15					Boring Terminated at 15 Feet	15.0							
20													
25													
30													
35													

SHEAR STRENGTH: Penetrometer, Torvane, Field Vane, Unconfined, Triaxial, Miniature Vane; TONS PER SQ FT 0.5 1 1.5 2 2.5

NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/20/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 15
WATER LEVEL: 10'
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING D-2
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'34.33"N 91° 2'15.30"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0	Gray and Brown LEAN CLAY (CL) with gravel and roots				21.7	43	18	25
	Gray and Tan LEAN CLAY (CL)				20.2			
5	Greenish Gray LEAN CLAY (CL) with ferrous stains				27.0	45	20	25
	Gray LEAN CLAY (CL)				24.7			
	Gray FAT CLAY (CH) with silt	8.0			26.4	52	17	35
10								
	Gray FAT CLAY (CH) with silt				23.8			
15	Boring Terminated at 15 Feet	15.0						
20								
25								
30								
35								

SHEAR STRENGTH
Penetrometer, Torvane, Field Vane, Unconfined, Triaxial, Miniature Vane
TONS PER SQ FT: 0.5, 1, 1.5, 2, 2.5

NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 15
WATER LEVEL: 10'
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING D-3
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'29.47"N 91° 2'18.18"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH (TONS PER SQ FT)
0					FILL - Brown, Dark Gray and Black LEAN CLAY (CL) with roots				21.0				
						2.0							
					Tan, Light Gray and Gray FAT CLAY (CH) with silt				22.6	51	17	34	
					Brown, Gray and Light Gray FAT CLAY (CH)				26.9				
5													
					Gray and Tan FAT CLAY (CH) with silt				23.5	51	19	32	
					Gray FAT CLAY (CH) with silt				24.8				
10													
					Gray FAT CLAY (CH) with silt				24.5	57	17	40	
15					Boring Terminated at 15 Feet	15.0							
20													
25													
30													
35													

SHEAR STRENGTH: ☐ Penetrometer ■ Unconfined ◇ Torvane ● Triaxial △ Field Vane ▲ Miniature Vane

TONS PER SQ FT: 0.5 1 1.5 2 2.5

NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/22/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 15
WATER LEVEL: 10'
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING D-4
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'29.72"N 91° 2'17.18"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0	Brown and Black FAT CLAY (CH) with silt and roots				16.3	52	23	29
	Tan, Gray and Brown LEAN CLAY (CL)	2.0			24.9			
5	Greenish Gray and Gray LEAN CLAY (CL) with silt seams				20.0	46	19	27
	Gray and Brown LEAN CLAY (CL)				22.9			
	Gray FAT CLAY (CH) with silt and ferrous nodules	8.0			26.7	63	23	40
10								
	Gray and Tan FAT CLAY (CH) with silt				25.5			
15	Boring Terminated at 15 Feet	15.0						
20								
25								
30								
35								

SHEAR STRENGTH
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane
TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/22/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 15
WATER LEVEL: 10'
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING D-5
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'30.09"N 91° 2'18.98"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH (TONS PER SQ FT)
0					FILL - Tan, Gray, Light Gray and Brown FAT CLAY (CH) with silt				22.7				
						2.0							
					Tan, Gray and Light Gray FAT CLAY (CH) with silt				28.6	69	18	51	
					Gray and Dark Gray FAT CLAY (CH)				23.2				
5													
					Gray, Light Gray, and Tan FAT CLAY (CH) with silt				23.2	65	24	41	
	▼				Gray, Black and Brown FAT CLAY (CH) with organics				23.1				
10	▽												
					Gray FAT CLAY (CH) with silt				25.0	57	21	36	
15					Boring Terminated at 15 Feet	15.0							
20													
25													
30													
35													

SHEAR STRENGTH: □ Penetrometer ■ Unconfined ◇ Torvane ● Triaxial △ Field Vane ▲ Miniature Vane

NOTES:
AFTER 15 MINUTES, GROUNDWATER LEVEL ROSE TO 8 FEET.

DRILLED DATE: 3/22/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 15
WATER LEVEL: 10'
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING D-6
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'29.40"N 91° 2'16.59"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Stiff, Tan, Light Gray and Gray FAT CLAY (CH) with trace sand Sand: 2.6% Silt: 43.9% Clay: 53.5%		101.6	97.4	21.1	68	20	48	
2					Gray and Brown FAT CLAY (CH) with silt and ferrous stains				25.8				
4					Gray LEAN CLAY (CL) with fine sand	4.0			20.2				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane
TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/22/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-1
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'29.34"N 91° 2'16.51"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Tan and Gray FAT CLAY (CH) with silt				19.8				
2					Gray and Tan FAT CLAY (CH) with silt pockets				26.0	67	20	47	
4					Gray and Tan FAT CLAY (CH) with silt and organics				21.8				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH: □ Penetrometer ■ Unconfined ◇ Torvane ● Triaxial △ Field Vane ▲ Miniature Vane
TONS PER SQ FT: 0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/22/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-2
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'29.26"N 91° 2'16.42"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					7" CONCRETE								
					Dark Gray and Brown LEAN CLAY (CL)	0.6			17.8				
2					Gray and Brown LEAN CLAY (CL) with organics				20.0				
4					Gray and Tan LEAN CLAY (CL)				21.8	41	19	22	
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH: □ Penetrometer ■ Unconfined ◇ Torvane ● Triaxial △ Field Vane ▲ Miniature Vane
TONS PER SQ FT: 0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/22/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-3
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'29.19"N 91° 2'16.33"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Brown and Dark Gray FAT CLAY (CH) with silt				23.5	51	20	31	
2					Tan and Gray FAT CLAY (CH)				30.2				
4					Gray LEAN CLAY (CL) with roots, gravel and fine sand	4.0			21.1				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH: □ Penetrometer ■ Unconfined ◇ Torvane ● Triaxial △ Field Vane ▲ Miniature Vane
TONS PER SQ FT: 0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/22/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-4
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'29.13"N 91° 2'16.25"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Dark Gray and Brown LEAN CLAY (CL) with roots and gravel				20.0				
2					Stiff, Tan, Gray and Brown FAT CLAY (CH) with silt	2.0	99.6		24.8	61	19	42	
4					Blue, Gray and Tan FAT CLAY (CH) with wood fragments				21.0				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane
TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/22/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-5
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'31.84"N 91° 2'14.30"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Gray and Tan LEAN CLAY (CL) with roots				18.8				
2					Gray FAT CLAY (CH) with silt	2.0			23.5				
4					Very Soft, Gray and Tan LEAN CLAY (CL)	4.0	91.0		29.3	38	22	16	■
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane
TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-6
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'31.78"N 91° 2'14.17"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH (TONS PER SQ FT)
0					6" CONCRETE								
					Gray and Tan LEAN CLAY (CL) with ferrous stains	0.5			21.4	49	18	31	
2					Gray and Tan FAT CLAY (CH) with silt	2.0			20.4				
4					Gray LEAN CLAY (CL)	4.0			26.0				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH: Penetrometer, Torvane, Field Vane, Unconfined, Triaxial, Miniature Vane; TONS PER SQ FT: 0.5, 1, 1.5, 2, 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-7
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'31.73"N 91° 2'14.04"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					7" CONCRETE								
					Gray and Tan LEAN CLAY (CL)	0.6			19.6				
2					Stiff, Gray and Tan LEAN CLAY (CL) with roots and organics pockets		91.2		27.5	39	18	21	■
4					Gray and Light Gray LEAN CLAY (CL) with wood fragments				16.7				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane
TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-8
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'31.69"N 91° 2'13.91"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH (TONS PER SQ FT)
0					6" CONCRETE								
					Gray, Tan and Light Gray FAT CLAY (CH) with silt	0.5			20.3				
2					Light Gray, Gray and Black LEAN CLAY (CL) with organics	2.0			19.6				
4					Greenish Gray LEAN CLAY (CL)				18.7	38	19	18	
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH: Penetrometer, Torvane, Field Vane, Unconfined, Triaxial, Miniature Vane; TONS PER SQ FT 0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-9
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'31.63"N 91° 2'13.76"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Stiff, Gray and Tan LEAN CLAY (CL) with roots and trace sand Sand: 8.7% Silt: 56.1% Clay: 35.2%		105.5	91.3	19.3	44	19	25	
2					Gray and Tan LEAN CLAY (CL)				17.6				
4					Gray LEAN CLAY (CL)				25.9				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH

□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane

TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-10
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'33.63"N 91° 2'13.63"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Gray, Tan and Brown LEAN CLAY (CL) with roots				21.5				
2					Stiff, Tan, Light Gray and Gray LEAN CLAY (CL) with silt and trace sand Sand: 3.2% Silt: 64.2% Clay: 32.6%		103.4	96.8	21.7	47	20	27	■
4					Gray LEAN CLAY (CL)				24.9				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane
TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-11
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'33.57"N 91° 2'13.49"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Gray and Tan FAT CLAY (CH) with silt				21.2				
2					Gray and Tan LEAN CLAY (CL)	2.0			19.2				
4					Light Gray, Tan and Gray LEAN CLAY (CL)				20.5	33	22	10	
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane
TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-12
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'33.51"N 91° 2'13.33"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0					6" CONCRETE							
					Stiff, Tan and Gray LEAN CLAY (CL)	0.5	97.1		26.7	46	20	26
2					Gray and Tan LEAN CLAY (CL)				16.5			
4					Gray and Light Gray LEAN CLAY (CL)				22.4			
6					Boring Terminated at 6 Feet	6.0						
8												
10												
12												
14												

SHEAR STRENGTH

□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane

TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-13
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'33.44"N 91° 2'13.18"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH (TONS PER SQ FT)
0					6" CONCRETE								
					FILL - Gray and Tan FAT CLAY (CH)	0.5			25.2	53	17	36	
2					Gray and Tan FAT CLAY (CH) with aggregate and silt	2.0			17.0				
4					Gray LEAN CLAY (CL) with organics	4.0			22.9				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

Penetrometer ■ Unconfined
Torvane ● Triaxial
Field Vane ▲ Miniature Vane
TONS PER SQ FT: 0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-14
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'33.38"N 91° 2'13.03"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					6" CONCRETE								
					Tan and Gray FAT CLAY (CH) with silt pockets	0.5			25.0				
2					Gray and Dark Gray FAT CLAY (CH) with organics				25.3				
4					Stiff, Gray and Tan FAT CLAY (CH) with silt		103.9		21.4	59	18	41	■
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane
TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-15
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'33.82"N 91° 2'17.99"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Dark Gray and Brown LEAN CLAY (CL) with gravel				18.5	46	20	26	
2					Gray and Tan LEAN CLAY (CL) with silt seams				19.8				
4					Gray and Tan LEAN CLAY (CL)				24.5				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH: □ Penetrometer ■ Unconfined ◇ Torvane ● Triaxial △ Field Vane ▲ Miniature Vane
TONS PER SQ FT: 0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/20/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-16
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'33.03"N 91° 2'15.58"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					FILL - Tan, Brown and Gray FAT CLAY (CH) with silt seams				18.0				
2					Tan and Light Gray LEAN CLAY (CL)	2.0			17.6	42	19	23	
4					Gray LEAN CLAY (CL)				28.5				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane
TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/20/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-17
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'34.46"N 91° 2'17.13"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)
0					Very Stiff, Tan and Gray LEAN CLAY (CL) with aggregate		108.8		18.6	40	18	22
2					Gray and Tan LEAN CLAY (CL)				22.0			
4					Gray and Tan LEAN CLAY (CL)				22.1			
6					Boring Terminated at 6 Feet	6.0						
8												
10												
12												
14												

SHEAR STRENGTH

□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane

TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/20/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-18
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'33.65"N 91° 2'15.67"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Tan, Gray and Red LEAN CLAY (CL)				21.1				
2					Gray, Tan and Greenish Gray FAT CLAY (CH) with silt Sand: 0.5% Silt: 57.8% Clay: 41.7%	2.0		99.5	16.9				
4					Medium, Gray FAT CLAY (CH) with silt Sand: 0.5% Silt: 57.8% Clay: 41.7%		90.1	99.5	28.4	51	20	31	■
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane
TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/20/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-19
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'31.65"N 91° 2'15.45"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)
0					Gray FAT CLAY (CH) with silt				22.9			
2					Very Stiff, Tan and Gray LEAN CLAY (CL)	2.0	103.4		21.0	48	19	29
4					Gray LEAN CLAY (CL)				29.1			
6					Boring Terminated at 6 Feet	6.0						
8												
10												
12												
14												

SHEAR STRENGTH

□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane

TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 3/21/2023
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-20
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'30.16"N 91° 2'16.52"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					FILL - Dark Gray and Tan FAT CLAY (CH) with silt				20.4				
2					Greenish Gray and Gray LEAN CLAY (CL)	2.0			20.9				
4					Gray and Greenish Gray LEAN CLAY (CL)				22.3	37	22	15	
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane
TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE:
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-21
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'31.57"N 91° 2'19.58"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Stiff, Tan and Gray FAT CLAY (CH)		97.4		24.9	67	24	43	
2					Gray and Dark Gray LEAN CLAY (CL) with gravel	2.0			24.4				
4					Gray, Brown and Black LEAN CLAY (CL) with roots				25.2				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH

□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane

TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE:
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-22
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'29.39"N 91° 2'18.82"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	PASSING NO 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH (TONS PER SQ FT)
0					Brown and Tan FAT CLAY (CH) with silt pockets				21.4				
2					Stiff, Tan and Light Gray FAT CLAY (CH)		95.3		27.6	78	21	57	■ at 1
4					Gray, Brown and Tan LEAN CLAY (CL)	4.0			19.1				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

Penetrometer ◇ Torvane △ Field Vane ■ Unconfined ● Triaxial ▲ Miniature Vane

TONS PER SQ FT: 0.5, 1, 1.5, 2, 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE:
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-23
SPECIALTY SURGICAL HOSPITAL

PLATE

PREMIER FILE# 23-0086

Premier GEOTECH AND TESTING, LLC

LOCATION: BATON ROUGE, LA
COORDINATES: 30°23'30.18"N 91° 2'18.16"W

SURFACE EL.: EXISTING GRADE

DEPTH, FT	WATER LEVEL	SYMBOL	SAMPLES	BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	CLASSIFICATION: UNIT DRY WT, PCF	CLASSIFICATION: PASSING NO 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH
0					Tan and Brown LEAN CLAY (CL)				20.7	49	23	26	
2					Tan and Light Gray FAT CLAY (CH)	2.0			27.2				
4					Gray, Brown and Tan LEAN CLAY (CL) with roots	4.0			23.2				
6					Boring Terminated at 6 Feet	6.0							
8													
10													
12													
14													

SHEAR STRENGTH
□ Penetrometer ■ Unconfined
◇ Torvane ● Triaxial
△ Field Vane ▲ Miniature Vane
TONS PER SQ FT
0.5 1 1.5 2 2.5

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE:
DRILLER: PREMIER GEOTECH
LOGGER: K.M.
TOTAL DEPTH (Ft): 6
WATER LEVEL: NE
BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-24
SPECIALTY SURGICAL HOSPITAL

PLATE

May 19, 2023

Stumberg Medical, LLC
PO Box 80063
Baton Rouge, Louisiana 70898

Attention: Mr. Michael Divicinti

Re: Alternate Foundation Recommendations
Proposed Specialty Surgical Hospital
Baton Rouge, Louisiana
Premier File No.: 23-0086 Addendum 01

Dear Mr. Divicinti:

Per your team request, Premier Geotech and Testing, LLC (Premier) is pleased to submit this addendum letter report to transmit alternate foundation recommendations for the proposed Specialty Surgical Hospital project.

This addendum letter supplements Premier's previously submitted Geotechnical Engineering Report (i.e., Premier File No.: 23-0086, dated May 12, 2023). All other provisions and recommendations presented in the aforementioned Premier report shall remain in full and strict effect.

Respectfully submitted,
Premier Geotech and Testing, LLC

Mike Juneau, P.E., MBA
President

Brenda Novoa, P.E., MSCE
Senior Geotechnical Engineer

ALTERNATE FOUNDATION RECOMMENDATIONS

Traditional Slab-on-Grade

As requested, instead of a post-tensioned BRAB Type III slab, a traditional slab-on-grade can be used for the proposed building provided the following conditions are achieved:

- At least two (2) feet of properly compacted structural fill is placed to achieve design grade;
- At least three (3) feet of the existing subsurface soils are over-excavated and replaced with properly compacted structural fill; **and**,
- Moisture conditioning of the exposed soils (after over-excavation) is performed.

If these conditions are accomplished, the PVR is anticipated to be less than one (1) inch.

Shallow Foundation Recommendations

Bearing Capacity

Based on the provided structural loads and subsurface soil conditions encountered in our test boring locations, the proposed structure may be supported on a shallow foundation system. **Square spread and continuous footings bearing at least 18 inches below finished grade, within properly compacted structural fill, may be designed for a net allowable bearing capacity of 1,250 pounds per square foot (psf), and 1,000 psf, respectively.** A minimum dimension of 24 inches for the square spread footing and 18 inches for the continuous footing should be used in the foundation design to reduce the possibility of a local bearing failure.

The foundation excavations should be observed by a representative of Premier prior to steel or concrete placement in order to assess the condition of the foundation materials is consistent with the materials discussed in this report. Soft or loose soil zones encountered at the bottom of the footing excavations should be removed and replaced with properly compacted structural fill as directed by the Geotechnical Engineer.

After opening and observation of foundation excavations, concrete should be placed as quickly as possible to avoid exposure of the foundations bottom to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. The foundation concrete should be placed during the same day the excavation is made. If it is required that foundation excavations be left open for more than one day, they should be protected to reduce evaporation or entry of moisture.

Estimated Settlement

We estimated the settlement behavior of shallow foundations based on the results of our laboratory testing and our experience with similar soil conditions. Settlement was estimated based on total sustained dead loads of 70% of the above recommended net allowable bearing pressure plus up to two (2) feet of fill material, using empirical correlations between Atterberg Limits and compressibility. A detailed settlement analysis was beyond the scope of our services.

Total settlement of individual isolated shallow footings with widths less than six (6) feet and continuous footings up to two (2) feet in width and placement of up to two (2) feet of fill material in accordance with the recommendations presented herein, is expected to be about 1.8 inches. However, we anticipate about 25 to 30 percent of the estimated settlement to occur during construction. Therefore, post construction settlement is anticipated to be about 1.25 inches. All things being equal, differential settlements are expected to be about half of the total settlements.

REPORT LIMITATIONS

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which Geotechnical Engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned. The engineering recommendations presented in the preceding sections constitute Premier's professional estimate of those measures that are necessary for the proposed structure(s) to perform according to the proposed design based on the information generated and referenced during this evaluation, and Premier's experience in working with those conditions.

The recommendations submitted in this report are based on furnished project information by the design team and the subsurface information obtained from borings drilled by Premier. If there are any revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, Premier must be notified immediately to determine if changes in the foundation recommendations are required. If Premier is not notified in writing of such changes, Premier will not be responsible for the impact of those changes on the project. The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are complete, the Geotechnical Engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our geotechnical engineering recommendations have been properly incorporated into the design documents.

The scope of Premier's services did not include any environmental assessment or investigation for the presence or absence or hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied. Any statements in this report regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of our Client.

This report and the information/data provided have been prepared for the exclusive use of Stumberg Medical, LLC and their design team for the specific application to the proposed

Specialty Surgical Hospital project to be located in Baton Rouge, Louisiana. The information and data obtained and prepared (i.e., Instrument of Service) by Premier Geotech and Testing, LLC may not be used or relied on by any other entity, now or at any point in the future, without the express, written consent from Premier Geotech and Testing, LLC.