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Bid Document Specifications 10.26.2023

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DOCUMENT 002600 - PROCUREMENT SUBSTITUTION PROCEDURES

1.1 DEFINITIONS

- A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.
- B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 012500 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 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.

1.3 PROCUREMENT SUBSTITUTIONS

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:
 - 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
 - 3. The request is fully documented and properly submitted.

1.4 SUBMITTALS

- A. Procurement Substitution Request: Submit to Architect Procurement Substitution Request must be made in writing by prime contract Bidder only in compliance with the following requirements:
 - 1. Requests for substitution of materials and equipment will be considered if received no later than 10 days prior to date of bid opening.
 - 2. Submittal Format: Email CSI Substitution Request Form 1.5C
 - a. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and drawing numbers.
 - b. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:
 - 1) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.
 - 2) Copies of current, independent third-party test data of salient product or system characteristics.

- 3) Samples where applicable or when requested by Architect.
 - 4) Detailed comparison of significant qualities of the proposed substitute with those of the Work specified. 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.
 - 5) Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - 6) Research reports, where applicable, evidencing compliance with building code in effect for Project.
 - 7) Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which will become necessary to accommodate the proposed substitute.
- c. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
 - d. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.
- B. Architect's Action:
1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.
- C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

END OF DOCUMENT 002600

PROJECT FORMS

PART 1 – GENERAL

1.1 FORM OF AGREEMENT AND GENERAL CONDITIONS

- A. The following form of Owner/Contractor Agreement and form of the General Conditions shall be used for Project:
 - 1. AIA Document A102, "Standard Form of Agreement between Owner and Contractor, Cost Plus with GMP"
 - a. The General Conditions for Project are AIA Document A201 2017, "General Conditions of the Contract for Construction."
 - 2. The General Conditions are available at the office of the Architect by request.
 - 3. The Supplementary Conditions for Project are separately prepared and included in the Project Manual.

1.2 ADMINISTRATIVE FORMS

- A. Administrative Forms: Additional administrative forms are specified in Division 01 General Requirements.
- B. Preconstruction Forms:
 - 1. Form of Certificate of Insurance: AIA Document G715
 - a. The Commercial General Liability Insurance and Automobile Liability Insurance must show "[OWNER], its subsidiary and affiliated companies, and limited liability companies" as an additional insured and shall be primary with respect to any other insurance or self-insurance afforded to Enterprise.
Certificate Holder name should read as follows:
- C. Information and Modification Forms:
 - 1. Form for Requests for Information (RFIs): Contractor's Standard Form.
 - 2. Form of Request for Proposal: Architect's Standard Form.
 - 3. Change Order Form: AIA Document G701, "Change Order."
 - 4. Form of Architect's Memorandum for Minor Changes in the Work: Architect's Standard Form.
 - 5. Form of Change Directive: AIA Document G714, "Construction Change Directive."
- D. Payment Forms:
 - 1. Schedule of Values Form: AIA Document G703, "Continuation Sheet."
 - 2. Payment Application: AIA Document G702/703, "Application and Certificate for Payment and Continuation Sheet."
 - 3. Form of Contractor's Affidavit: AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 - 4. Form of Affidavit of Release of Liens: AIA Document G706A, "Contractor's Affidavit of Payment of Release of Liens."
 - 5. Form of Consent of Surety: AIA Document G707, "Consent of Surety to Final Payment."

END OF SECTION 006000

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions modify, change, delete from or add to the General Conditions of the Contract for Construction, AIA Document A201, 2017 Edition. Where any Article of the General Conditions is modified or any Section, Paragraph, Subparagraph or Clause thereof is modified or deleted by these supplements, the unaltered provisions of that Section, Article, Paragraph, Subparagraph or Clause shall remain in effect.

Articles, Sections, Paragraphs, Subparagraphs or Clauses modified or deleted have the same numerical designation as those occurring in the General Conditions.

ARTICLE 1

GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 The Contract Documents

In Section 1.1.1 delete the third sentence, and add the following sentence:

The Contract Documents shall include the Bid Documents as listed in the Instructions to Bidders and any modifications made thereto by addenda.

1.8 BUILDING INFORMATION MODELS USE AND RELIANCE

Delete Section 1.8.

ARTICLE 2

OWNER

2.2 EVIDENCE OF THE OWNER'S FINANCIAL ARRANGEMENTS

Delete Section 2.2.

ARTICLE 3

CONTRACTOR

3.4 LABOR AND MATERIALS

3.4.2 Delete Section 3.4.2.

Delete Section 3.4.3 and substitute with the following:

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 be removed 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

3.5.2 Replace reference to "Section 9.8.4" with "Section 9.8.6".

3.7 PERMITS, FEES, NOTICES, AND COMPLIANCE WITH LAWS (La R.S. 40:1724[A])

Delete Section 3.7.5 and substitute the following:

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.

3.9 SUPERINTENDENT

3.9.1 Add the following to the end of the paragraph:
Important communications shall be confirmed in writing. Other communications shall be similarly confirmed on written request in each case.

3.10 CONTRACTOR'S CONSTRUCTION AND SUBMITTAL SCHEDULES

3.10.1 Add the following: 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. No payment shall be made until this schedule is received.

3.10.3 In the first sentence, delete the word "general".

After the first sentence, add the following:

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.

Add the following Sections:

3.10.4 In the event the Owner employs a commissioning consultant, the Contractor shall cooperate fully in the commissioning process and shall require all subcontractors and others 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

Add the following: 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.

ARTICLE 4

ARCHITECT

4.2 ADMINISTRATION OF THE CONTRACT

4.2.2 In the first sentence, after the phrase: "become generally familiar with"; insert the following: "and to keep the Owner informed about".

In the first sentence, after the phrase "portion of the Work completed", insert the following: "to endeavor to guard the Owner against defects and deficiencies in the Work,"

SUPPLEMENTARY CONDITIONS

4.2.10 Add the following sentence to the end of Section 4.2.10: There shall be no restriction on the Owner having a Representative.

4.2.11 Add the following sentence to the end of Section 4.2.11:

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.

4.2.14 Insert the following sentence between the second and third sentences of Section 4.2.14:

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.

ARTICLE 5

SUBCONTRACTORS

5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

Delete Sections 5.4, 5.4.1, 5.4.2 and 5.4.3

ARTICLE 7

CHANGES IN THE WORK

7.1 GENERAL

Add the following Sections:

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 owned equipment.

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

7.2 CHANGE ORDERS

Delete Section 7.2.1, and substitute the following Sections:

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:

SUPPLEMENTARY CONDITIONS

- 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" is 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 materials 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 compressors, 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 increases in "Builder's Risk" insurance premium / costs 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 7.5% 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; 3.75% markup on the Cost of the Work.
- 7.2.4.2 When the Work is all Subcontract Work; 3.75% markup on the Cost of the Work for Subcontractor's Overhead and Profit, plus 3.75% 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

7.3.3 In the first sentence after "following methods" insert: ", but not to exceed a specified amount".

7.3.4 From .1 of the list, delete all after "Costs of labor, including" and substitute the following "social security, old age and employment insurance, applicable payroll taxes, and workers' compensation insurance;"

Delete Section 7.3.9 and substitute the following:

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.

ARTICLE 8

TIME

8.1 DEFINITIONS

Add the following:

SUPPLEMENTARY CONDITIONS

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

Add to Section 8.2.1 the following:

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.

Delete Section 8.2.2.

8.3 DELAYS AND EXTENSIONS OF TIME

8.3.1 In the first sentence after the words "Owner pending" delete the words "mediation and binding dispute resolution" and add the word "litigation", and delete the last word "determine" and add the following: "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."

ARTICLE 9

PAYMENTS AND COMPLETION

9.1 CONTRACT SUM

Delete Section 9.1.2.

9.3 APPLICATIONS FOR PAYMENT

add the following:

9.3.1.3 Normal Retainage shall be 5% of the Contract Price. 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.

9.5 DECISIONS TO WITHHOLD CERTIFICATION

Section 9.5.1.7: Delete the word "repeated".

Delete Section 9.5.4.

9.6 PROGRESS PAYMENTS

9.6.2 Delete the phrase: "no later than seven days" from the first sentence.

After the end of the second sentence, add the following:

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.

SUPPLEMENTARY CONDITIONS

- 9.6.4 Delete the first two sentences of Section 9.6.4 and add the following to the end of the Section:

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.

Delete Section **9.7 FAILURE OF PAYMENT.**

Delete Section 9.8 and substitute the following:

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.

9.9 PARTIAL OCCUPANCY OR USE

Delete Section 9.9.1 and substitute the following:

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.

9.10 FINAL COMPLETION AND FINAL PAYMENT

Delete Section 9.10.4 and replace with the following:

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.

ARTICLE 10

PROTECTION OF PERSONS AND PROPERTY

10.2 SAFETY OF PERSONS AND PROPERTY

10.2.2 In the first sentence, between the words: "bearing on" and "safety", add the words: "the health and,"

10.3 HAZARDOUS MATERIALS

10.3.1 In the second sentence after (PCB) add: "or lead".

10.3.2 After the first sentence, delete all remaining sentences.

Add at the end: "The Contract time shall be extended appropriately."

Delete Section 10.4 and substitute the following:

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.

ARTICLE 11

SUPPLEMENTARY CONDITIONS

INSURANCE AND BONDS

AIA A101 – 2017 Exhibit A is not a part of these documents. Delete all of Sections 11.1, 11.2, 11.3, 11.4, and 11.5, and substitute the following:

ARTICLE 12

UNCOVERING AND CORRECTION OF WORK

12.2 CORRECTION OF WORK

12.2.1 Before Substantial Completion

At the end of the paragraph, add the following sentences:

"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 At the end of the paragraph delete the last sentence and add the following sentences:

"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."

ARTICLE 13

MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Delete all after the word "located".

13.2 SUCCESSORS AND ASSIGNS

13.2.1 In the second sentence, delete "Except as ... 13.2.2"

Delete Section 13.2.2.

13.4 TESTS AND INSPECTIONS

In Section 13.4.1, delete the second sentence and substitute the following:

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.

Delete the last two sentences of Section 13.4.1.

SUPPLEMENTARY CONDITIONS

13.5 INTEREST

Delete Section 13.5.

ARTICLE 14

TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 TERMINATION BY THE CONTRACTOR

Delete Section 14.1.1.4.

In Section 14.1.3, after the word "profit," delete the words "on Work not executed" and substitute the following: "for Work completed prior to stoppage".

14.2 TERMINATION BY THE OWNER FOR CAUSE

Add the following Section:

14.2.1.5 failure to complete the punch list within the lien period as provided in 9.8.7.

14.2.3 Add the following sentence:

"Termination by the Owner shall not suspend assessment of liquidated damages against the Surety."

Add the following Section:

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.

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

In Section 14.4.3, delete all after "incurred by reason of the termination," and add "along with reasonable profit on the Work not executed."

ARTICLE 15

CLAIMS AND DISPUTES

15.1 CLAIMS

Delete Section 15.1.2, **Time Limit on Claims**, (See La R.S. 38:2189, and 38:2189.1).

15.1.3.1 Add the following to the end of the paragraph:

"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."

15.1.4.2 In the first sentence of the Section, delete "Initial Decision Maker's" and replace with "Architect's". In the second sentence of the Section, delete "the decision of the Initial Decision Maker" and replace with: "his/her decision".

Delete Section 15.1.6.2 and substitute the following:

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

SUPPLEMENTARY CONDITIONS

days associated with a National Weather Service named storm or federally declared weather related disaster directly affecting the project site.

Add the following Section:

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

| | | | |
|----------|----------------|-----------|---------------|
| January | <u>11</u> days | July | <u>6</u> days |
| February | <u>10</u> days | August | <u>5</u> days |
| March | <u>8</u> days | September | <u>4</u> days |
| April | <u>7</u> days | October | <u>3</u> days |
| May | <u>5</u> days | November | <u>5</u> days |
| June | <u>6</u> days | December | <u>8</u> 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.

15.2 INITIAL DECISION

15.2.1 In the second sentence, delete the word "will" and replace with: "shall always".

In the second sentence, delete the phrase: ", unless otherwise indicated in the Agreement."

At the end of the third sentence, add: "arising prior to the date final payment is due".

Delete the fourth sentence.

15.2.5 In the middle of the first sentence, delete all after the phrase: "rejecting the Claim".

In the second sentence, delete the phrase: "and the Architect, if the Architect is not serving as the Initial Decision Maker,".

In the third sentence, delete all after: "binding on the parties" and add the following: "except that the Owner may reject the decision or suggest a compromise or both".

Delete Section 15.2.6.

Delete Section 15.2.6.1.

15.3 MEDIATION

Delete Section 15.3.

15.4 ARBITRATION

Delete Section 15.4.

- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 (minimum yield stress in ksi), G60 zinc coating. At all exposed conditions, galvanized deck shall be cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer. Verify compatibility with top coat specified by Architect.
 2. Deck Profile: As indicated.
 3. Profile Depth: As indicated.
 4. Design Uncoated-Steel Thickness: As indicated.
 5. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated.
 6. Span Condition: Triple span or more unless not permitted by geometry.
 7. Side Laps: Overlapped.

2.3 COMPOSITE FLOOR DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Canam Steel Corporation.
 2. Epic Metals Corporation.
 3. New Millennium Building Systems, LLC.
 4. Nucor Corp.; Vulcraft Group. (design basis on structural plans)
 5. Valley Joist.
 6. DACS, Inc.
 7. Cordeck.
 8. Consolidated Systems, Inc.
- B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 (minimum yield stress in ksi), G60 zinc coating. At all exposed conditions, the top surface of galvanized deck shall be unpainted and underside surface shall be cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer. Verify compatibility with top coat specified by Architect.
 2. Profile Depth: As indicated.
 3. Design Uncoated-Steel Thickness: As indicated.
 4. Span Condition: Triple span or more unless not permitted by geometry.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Project Conditions: Verify that installation conditions specified in PART 1 - GENERAL have been achieved and can be maintained.
- B. Protection: Provide and maintain temporary protection of gypsum board from direct exposure to rain, snow, sunlight, or other excessive weather conditions.
- C. Damaged Gypsum Board: Gypsum board products that have become exposed to rain or water ponding at the floor line shall be replaced at the discretion of the Architect to an appropriate level, but not less than 4' - 0" above the finished floor line.
- D. 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.
- E. Acceptance: Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Ceiling Anchorages: Coordinate ceiling suspension systems with overhead structural assemblies to ensure that provisions to receive ceiling hangers will develop their full strength and are at spacing required to support ceilings.

3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.
- 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 USG Co.
- C. Structural Isolation: Isolate steel framing from building to prevent transfer of loading imposed by structural movement. Provide isolation at the following locations:
 - 1. Where building structure abuts ceiling perimeter or penetrates ceiling.
 - 2. Where partition framing and wall furring abut structure except at floor.
 - a. Provide deflection tracks to attain lateral support and avoid axial loading.
 - b. Provide Slip-Type Deflection Clips: Where framing extends to overhead structural supports, install deflection clips to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 3. Where fire-rated partitions extend to underside of structure. Provide deflection and firestop track top runner at fire-rated assemblies.
- D. Expansion Joints: Do not bridge building expansion and control joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

A. Section Includes:

- 1. Project information.
- 2. Work covered by Contract Documents.
- 3. Phased construction.
- 4. Work by Owner.
- 5. Work under separate contracts.
- 6. Future work.
- 7. Owner-furnished products.
- 8. Access to site.
- 9. Coordination with occupants.
- 10. Work restrictions.
- 11. Specification and drawing conventions.
- 12. Miscellaneous provisions.

B. Related Requirements:

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

1.3 PROJECT INFORMATION

A. Project Identification: THE NEWTRON GROUP – NEW CAMPUS HEADQUARTERS

- 1. Project Location: 13820 Airline Highway, Baton Rouge LA 70817

B. Owner: Newtron Development, LLC

- 1. Owner's Representative: Brian Bordelon

C. Architect:

- a. WTD Architecture / (225) 412-4885 / W. Tommy Dauzat, AIA - Principal
- b. MKE Architects / (225) 395.8678 / Kirk Edwards, AIA - Principal

D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

- 1. See sheet T0.01 for a list of the Architect's Consultants

- E. Other Owner Consultants: The Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:

- 1. See sheet A1.00 Supplemental Information for list of Owner's Consultants that will require coordination.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

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

The project consists of a 62,216 SF Two Story New Office Building/Operations Headquarters for the Newtron Group, corresponding parking, and sitework. The building will be constructed on a drilled shaft supported concrete foundation with a structural steel frame and a Thermoplastic-Polyethylene roofing system. Class A commercial Exterior and Interior building components and systems will be utilized in the construction of this facility.

- B. Type of Contract:

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

1.5 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

- B. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.

- 1. Data and Communications Wiring and Finish Out

1.6 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

- B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract. Owner will issue separate contract for the following:

1.7 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products. Owner-Furnished Products: N/A

1.8 ACCESS TO SITE

- A. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1.9 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: No limit with the exception of the following:
 - 1. Weekend Hours: No limit when approved by owner in advance.
 - 2. Early Morning Hours: No Limit with the exception of the following: Contractor must comply with the restrictions and regulations of the local authorities having jurisdiction for restrictions of noisy work.
 - 3. Hours for Utility Shutdowns: Limit work requiring utility shutdown to the 21 consecutive calendar day period where the facility will be closed when possible. If utility shutdown is required after this period, provide the owner with a minimum 48 hours' notice. Work to occur during non-business hours.
- C. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.10 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.

PEARL DENTAL GROUP – NEW OFFICE

1.11 MISCELLANEOUS PROVISIONS

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
- C. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 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.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three 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: Use CSI Form 13.1A
 - 2. 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.
3. 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.

1.5 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.

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 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. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 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.

1.2 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.

1.3 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, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 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 or 20 days, 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. Quotation Form: Use forms acceptable to Architect.
- 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.

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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 applicable taxes, 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 Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 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

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Work Change Directive: Architect may issue a Work Change Directive on AIA Document G714. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Work 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 Work Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 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. Use CSI Form 1.5A. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entities 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. Always keep list current.

1.5 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.

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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 and activities of other contractors 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.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, 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. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
9. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in CAD 2014.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect

1.7 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 in the form specified.
 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. RFI Forms: AIA Document G716
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated 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 Section 012600 "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.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number.
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- F. 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.

1.8 PROJECT MEETINGS

- A. General: 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: Contractor will schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect
 - 1. Conduct the conference to review responsibilities and personnel assignments.
 - 2. 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.
 - 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. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
 - 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

- C. Preinstallation Conferences: Conduct a preinstallation conference at project site before each construction activity that requires coordination with other construction.
 - 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the specific activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Contractor to schedule and conduct a project closeout conference, at a time convenient to Owner and Architect
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.

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- 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.
- E. Progress Meetings: Contractor will conduct weekly meetings at the site.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner and 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 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 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.

1.2 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. Construction reports
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting schedules and reports.

1.3 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.

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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.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.

- B. Startup construction schedule.

- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a copy of schedule

- D. Construction Schedule Updating Reports: Submit with Applications for Payment.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for 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. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion

1. Temporary enclosure and space conditioning.

- C. 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.

- D. 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

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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.

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

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
- B. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact to demonstrate the effect of the proposed change on the overall project schedule.

2.3 REPORTS

- A. Prepare a weekly construction report recording the following information concerning events at Project site:
 1. High and low temperatures and general weather conditions, including presence of rain or snow.
 2. Meetings and significant decisions.
 3. Unusual events (see special reports).
 4. Stoppages, delays, shortages, and losses.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At regular intervals, update schedule to reflect actual construction progress and activities. Issue schedule 3-days before each regularly scheduled progress meeting.
- B. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, 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 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 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.

1.2 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 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 2. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 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' 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. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- 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.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- 1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings. (deemed as necessary by architect)
 - 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 CAD
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement
 - d. Deemed as necessary by architect
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

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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 reserves 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 to 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., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-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 Construction Manager.
 - 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
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.

- s. Remarks.
- 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

2.1 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. Submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. 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.
- 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. Standard 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.

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- 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
 - 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. 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 three 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. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."
- 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 017700 "Closeout Procedures."
- J. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- 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.

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- 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.

2.2 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 paper copies of certificate, signed and sealed by the 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

3.1 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

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- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."
- 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 submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 3. Specific test and inspection requirements are not specified in this Section.

1.2 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 administration activities performed by Architect.
- C. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- E. 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).
- F. 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.

1.3 CONFLICT 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.

1.4 REPORTS AND DOCUMENTS

- A. Tests 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, 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 inspection.
 - 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.

1.5 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, applying, 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.

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- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's 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 observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.6 QUALITY CONTROL

- A. Owner Responsibilities: If quality-control services become necessary over-and-above those specified in individual sections, 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. 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. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect 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.
- C. Associated Services Contractor: 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

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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. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 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.

1.2 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.
 - 2. Section 321313 "Concrete Paving" for construction and maintenance of cement concrete pavement for temporary roads and paved areas.

1.3 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, Owner's construction forces, Architect, occupants of project, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Contractor Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Contractor Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Contractor Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 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.

1.5 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.

1.6 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

2.1 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 enough size to accommodate needs of Owner, Architect, and 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 enough size to accommodate meetings of individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall.
 - 3. Drinking water and private toilet.
 - 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 - 5. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) 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.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 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
- 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.

3.2 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 as directed by authorities having jurisdiction.
- C. 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.
- D. 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.
- E. 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.
- F. Electric Power Service: Provide electric power service and distribution system of enough size, capacity, and power characteristics required for construction operations.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install telephone line(s) for each field office.
 - 1. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 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 (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations.
 - 1. Provide dust-control treatment that is nonpolluting and non-tracking. Reapply treatment as required to minimize dust.
- C. 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.
- D. Parking: Provide temporary parking areas for construction personnel.
- E. 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.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 1. Identification Signs:
 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 always legible.
- G. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- I. 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.
- J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. 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.
- B. 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
 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 project.
 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- C. 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.

- D. 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. Perform control operations lawfully, using environmentally safe materials.

3.5 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 Phase: 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 Phase: 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 Phase 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 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.

3.6 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.

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- 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 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 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.

1.2 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.

Related Requirements:

1. Section 012500 "Substitution Procedures" for requests for substitutions.
2. Section 014200 "References" for applicable industry standards for products specified.

1.3 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.

1.4 ACTION SUBMITTALS

- A. 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 5 days of receipt of request, or 5 days of receipt of additional information or documentation, whichever is later.

- a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
- b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 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.

1.6 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.

1.7 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 other 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

2.1 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.
- 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 be considered
 - b. Nonrestricted 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 be considered.
 - b. Nonrestricted 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.
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.
- 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 Section 012500 "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.

2.2 COMPARABLE PRODUCTS

- A. 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 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following

1. Installation of the Work.
2. Cutting and patching.
3. Coordination of Owner-installed products.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.

1.3 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.

1.4 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.
 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.
 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.

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- B. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
 - 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

3.1 EXAMINATION

- A. 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.
- B. 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.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. 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.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

- C. 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 Section 013100 "Project Management and Coordination."

3.3 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 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

3.4 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 enough to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 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 (2440 mm)] in occupied spaces and 90 inches (2300 mm) 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.

3.6 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 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.

3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.

- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 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 (27 deg C).
 - 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.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- 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 015000 "Temporary Facilities and Controls.
- 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.

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- 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.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 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.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.

1.3 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.

1.4 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.

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1.5 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.2 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. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.3 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.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

3.4 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 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 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.

1.2 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.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for progress cleaning of Project site.

1.3 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.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 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.

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- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 14 calendar 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 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual 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.
 5. Submit test/adjust/balance records.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 14 calendar 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 14 calendar 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. Reinspection: Request reinspection 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.

1.7 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."

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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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 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.
1. Organize list of spaces in sequential order
 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. Architect will return annotated file.

1.9 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 (215-by-280-mm) 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.

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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.

PART 2 - PRODUCTS

2.1 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.
 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 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.

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- 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.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
 - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - q. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls"

3.2 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 the 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 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 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.

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- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 5 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 5 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority.

9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.

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4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria, if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

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- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.

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4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. 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 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 Work 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.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.

2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file
1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

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2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 033000 - CAST-IN-PLACE CONCRETE

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 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Grade beams.
 - 3. Slabs-on-grade.
 - 4. Foundation walls.
 - 5. Above grade slabs (cast-in-place or on metal decks)
 - 6. Concrete stairs and fill for metal pan stairs.
 - 7. Drilled piers and shafts.
- B. Related Sections include the following:
 - 1. Division 31 Section "Earth Moving At Building Pad" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement. None of the following are allowed in any concrete in this project: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: Submit a design mixture for each concrete mixture, proportioned on the basis of field experience or trial mixtures, or both, as required by ACI 318-14, chapter 26. Evidence of the ability of the proposed mixture to comply with concrete mixture requirements on the Drawings shall be included. The evidence shall be based on field test records or laboratory trial batches. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

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1. Indicate amount of mixing water to be withheld for later addition at Project site. The amount of water withheld shall not exceed five percent (5%) of the total batch water.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing but not limited to bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Reproductions made from contract drawings will not be accepted. Submit one (1) electronic print. Review of shop drawings by the Engineer will be for general compliance with contract documents.
- D. Field quality-control test and inspection reports.
- E. The scope of the above submittals shall only include the items covered by this Section. Do not include items covered by other Sections such as site paving product data, site paving design mixtures, or site paving steel reinforcement shop drawings.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site (with video teleconferencing capabilities) and verify acceptable date with Architect and Engineer a minimum of one week prior to scheduling.
 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
 3. Contact vapor barrier manufacturer for preinstallation meeting and to coordinate review of the vapor barrier installation either by digital review or in person.
- B. Preinstallation Conference Call: Conduct a preslab placement meeting via conference call for interior floor slabs on grade to be polished.
 1. Review special inspection, testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction, contraction and isolation joints, joint-filler ships, semirigid joint fillers, forms and form removal limitations, floor flatness and levelness measurement, concrete repair procedures, and concrete protection.
 2. The following representatives of each entity directly concerned with the floor slabs on grade are required to attend:
 - a. General Contractor's superintendent.
 - b. Ready-mix concrete manufacturer.
 - c. Concrete Contractor.

- d. Slab on grade finishing subcontractor.
- e. Conveying subcontractor.
- f. Polishing subcontractor.
- g. Owner's concrete consultant.
- h. Architect.

1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** A qualified installer who employs qualified personnel on the Project, Flatwork Technicians with at least three (3) years experience, Finishers with at least three (3) years experience and a Supervisor with at least ten (10) years experience in concrete finishing and flatwork.
- B. **Manufacturer Qualifications:** A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- C. **Testing Agency Qualifications:** An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. **Source Limitations:** Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. **Welding:** Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- F. **ACI Publications:** Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete for Buildings,"
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 3. ACI 318, "Building Code Requirements for Structural Concrete."
- G. **Concrete Testing Service:** Owner shall engage (and pay for) a qualified independent testing agency to perform material evaluation tests. Contractor shall engage and pay a qualified independent testing agency to design concrete mixtures.
- H. **Materials and installed work may require testing and retesting,** as directed by Architect, at anytime during progress of work. Allow free access to material stockpiles and facilities. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.
- I. **For all concrete placement events,** all steel reinforcement, other embedded items, and formwork shall be set and finalized a minimum of (3) three hours prior to the time of initial concrete placement to allow time for proper observation/inspection by the design team and the testing agency and time for resolution of any discrepancies.

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1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops (if required): Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Forms for Exposed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Forms for Unexposed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
 - 1. Form foundation elements as indicated on contract documents (typically placed in general notes of the structural plans).
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips (if required): Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
 - 1. All reinforcing bars to be welded shall be ASTM A706, deformed.
- B. Plain-Steel Wire: ASTM A 82.
- C. Deformed-Steel Wire: ASTM A 1064.

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- D. Plain-Steel Welded Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel Welded Wire Reinforcement: ASTM A 1064, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars (if required): ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view or weather where legs of wire bar supports contact forms (or occur within 1-1/2 inches of surface), use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use either of the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II unless otherwise acceptable to Architect.
 - 2. Blended Hydraulic Cement: ASTM C 595, Type IL (10), 10% limestone substitution.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal for regular sand and gravel mixtures.
 - 2. Maximum Coarse-Aggregate Size: 0.5 inch nominal for sand and pea gravel mixtures. Use a #8 stone aggregate gradation per ASTM C 33 for pea gravel aggregate.
 - 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement. Manufactured fine aggregate is prohibited.
- C. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.
- D. Water: ASTM C 94/C 94M and potable. Clean and not detrimental to concrete.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

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2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc; MiraSTOP.
 - b. CETCO; Volclay Waterstop-RX.
 - c. Concrete Sealants Inc.; Conseal CS-231.
 - d. Greenstreak; Swellstop.
 - e. Henry Company, Sealants Division; Hydro-Flex.
 - f. JP Specialties, Inc.; Earth Shield Type 20.

2.7 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape. The vapor retarder shall maintain a permeance of less than .01 perms as tested before and after mandatory conditioning tests (per ASTM E 1745 Section 7.1 and sub-paragraphs 7.1.2-5).
 1. Available Products:
 - a. Fortifiber Building Systems Group; Moistop Ultra.
 - b. Meadows, W. R., Inc.; Perminator.
 - c. Raven Industries Inc.; Vapor Block.
 - d. Reef Industries, Inc.; Griffolyn.
 - e. Stego Industries, LLC; Stego Wrap.
 2. Refer to contract plan documents for minimum vapor retarder thickness in mils.
 3. Vapor proofing mastic: water vapor transmission rate per ASTM E 96 of 0.3 perms or lower.
 4. Seam tape: must have a water vapor transmission rate of 0.3 perms or lower in accordance with ASTM E 96

2.8 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

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- D. Curing compounds must be approved for use with types of floor finishes and sealers/hardeners specified in Contract Documents. Curing compound shall not interfere with bonding of floor covering. The following list of compounds does not indicate acceptance with the floor finishes utilized. Contractor shall only submit for approval curing compounds that are guaranteed not to interfere with bonding of any floor covering. Contractor assumes all responsibility for compliance of curing compounds with respect to this requirement.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Available Products:
 - a. Ashford Formula
 - b. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - c. Burke by Edoco; Aqua Resin Cure.
 - d. ChemMasters; Safe-Cure Clear.
 - e. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
 - f. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
 - g. Euclid Chemical Company (The); Kurez DR VOX.
 - h. Kaufman Products, Inc.; Thinfilm 420.
 - i. Lambert Corporation; Aqua Kure-Clear.
 - j. L&M Construction Chemicals, Inc.; L&M Cure R.
 - k. Meadows, W. R., Inc.; 1100 Clear.
 - l. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
 - m. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
 - n. Tamms Industries, Inc.; Horncure WB 30.
 - o. Unitex; Hydro Cure 309.
 - p. US Mix Products Company; US Spec Maxcure Resin Clear.
 - q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
1. Available Products:
 - a. Ashford Formula
 - b. Anti-Hydro International, Inc.; AH Clear Cure WB.
 - c. Burke by Edoco; Spartan Cote WB II.
 - d. ChemMasters; Safe-Cure & Seal 20.
 - e. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Cure and Seal WB.
 - f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
 - g. Euclid Chemical Company (The); Aqua Cure VOX.
 - h. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
 - i. Lambert Corporation; Glazecote Sealer-20.
 - j. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - k. Meadows, W. R., Inc.; Vocomp-20.
 - l. Metalcrete Industries; Metcure.
 - m. Nox-Crete Products Group, Kinsman Corporation; Cure & Seal 150E.
 - n. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.
 - o. Tamms Industries, Inc.; Clearseal WB 150.
 - p. Unitex; Hydro Seal.
 - q. US Mix Products Company; US Spec Hydrasheen 15 percent
 - r. Vexcon Chemicals, Inc.; Starseal 309.

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips (if required): ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

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- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240.
- C. Reglets (if required): Fabricate reglets of not less than 0.0217-inch- thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- D. Dovetail Anchor Slots (if required): Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.10 REPAIR MATERIALS

- A. Repair Underlayment (if required): Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment (if required): Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - a. Do not use high-range water-reducing or super plasticizing admixtures in slabs.

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2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, and concrete required to be watertight.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 5. If more than one admixture is used in a concrete mix, assure that only compatible admixtures are used.
 6. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 - a. This requirement does not apply to lightweight concrete.
 - b. Air content for lightweight concrete shall comply with any fire-rated assembly requirements listed by Architect.
- D. Maximum W/C Ratio: 0.50 and as required to achieve specified concrete strength.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Design mixes to provide concrete with the properties as indicated on the structural drawings.

2.13 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information. The time concrete is unloaded shall be recorded on each batch ticket.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
 2. Batch ticket information shall include information necessary to calculate total mixing water and the amount of water added by the receiver.
- B. Project-Site Mixing is not allowed.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 117 and ACI 347R as abrupt or gradual, as follows:

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1. Class A, 1/8 inch for smooth-formed finished surfaces.
 2. Class C, 1/2 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete, unless otherwise indicated.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. Install and secure anchor rods prior to placing of concrete.
 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 4. Install dovetail anchor slots in concrete structures as indicated.
 5. Provide additional rebar if required to secure rebar dowels in proper location.

- B. Do not run any mechanical/electrical/plumbing pipes or conduit horizontally through concrete slabs, unless approved by the Engineer. These items shall also not bear continuously along grade beams and shall only cross perpendicular over top of grade beam in the concrete thickness below the slab at isolated locations.
- C. Do not run any mechanical/electrical/plumbing pipes or conduit through concrete footings and/or pile caps, unless approved by the Engineer. All mechanical/electrical/plumbing items shall be routed to avoid conflicts with concrete construction.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength but in no case shall forms be removed sooner than 10 days from placing of concrete for such elements.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
 - 2. Repair damaged areas by cutting patches of required vapor retarder, overlapping damaged area 6 inches and taping all four sides with approved tape.
 - 3. Seal all penetrations (including pipes) per manufacturer's instructions.
 - 4. The vapor retarder shall be sealed at the perimeter.
- B. If vapor barrier is installed before the grade beam pour, seal vapor barrier to the inside face of grade beams along the entire vapor barrier perimeter using tape with a surface that creates a mechanical seal to freshly-placed grade beam concrete, per manufacturer's instructions.
- C. If vapor barrier is installed after the grade beam pour, seal vapor barrier to the inside face of grade beams along the entire vapor barrier perimeter using tape and termination bar per manufacturer's instructions. Ensure the grade beam surface is clean and dry prior to adhering tape.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Maximum spacing of bar supports for slab/mat reinforcement shall be 48 inches on center or less as required to secure reinforcement during construction operations.
- E. Precast concrete blocks shall only be used to support reinforcement from the ground. Concrete blocks shall not be used for support of top reinforcement in concrete slabs or mats.
- F. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- G. Install bar reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap ends of bars as indicated on the structural contract drawings.
- H. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces as specified on drawings or a minimum of two full mesh if not otherwise specified. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Do not continue reinforcement through sides of strip placements of floors and slabs (unless noted otherwise on drawings).
 - 2. Form joints as indicated on drawings. Do not use metal keyways
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Construction joints shall not be placed in any slab areas with floor coverings prone to cracking, unless written approval is provided the Architect. When construction joints are allowed in slab areas with floor coverings prone to cracking, the contractor shall assure that joints are properly considered in floor covering installation as required to prevent reflective cracking.

- C. Doweled Joints (as indicated on drawings): Install dowel bars and support assemblies at joints where indicated.

3.7 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.
 - 1. Place at locations indicated on plans.
 - 2. Place at concrete construction joints below site grade in order to avoid water intrusion into interior space.
 - a. Place at wall to slab (or mat foundation) joints below site grade.
 - b. Place at wall to wall joints below site grade.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
 - 1. All embedded items, including anchor bolts, rebar dowels, etc., shall be set prior to placement of concrete.
 - 2. For foundation elements, verify that water is not present in the excavation prior to placement of concrete.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 and in accordance with ASTM C94.
 - 1. Determine initial slump prior to any water addition at Project site and before any significant concrete discharge.
 - 2. Measure and record water added on Project site and resulting slump.
 - 3. The amount of water added shall not exceed the amount allowed in the approved design mixture.
 - 4. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
 - 5. Do not exceed specified W/C ratio or slump per approved design mixture.
 - 6. Do not add water to concrete delivered in equipment not acceptable for mixing.
 - 7. Do not add water if more than 0.25 cubic yards of concrete has already been discharged from the mixer.
 - 8. All water added shall be under the pressure and direction of flow required to achieve uniformity in concrete. Immediately after addition of water, the drum or blades of the truck mixer or agitator shall be turned an additional 30 revolutions or more if necessary, at mixing speed, until uniformity of concrete is achieved.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

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1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not place concrete when temperature is 36 deg F or below or if temperature is expected to reach 36 deg F (or below) within 12 hours of the anticipated time for completing a concrete pour.
 3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 4. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301, ACI 305R, and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- G. All elevated concrete slabs in shored construction shall be placed with the minimum slab thickness indicated on the Drawings and shall also be constructed level as required to comply with flatness and levelness requirements as defined in ACI 117.

- H. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

3.9 CONCRETE PLACEMENT WHEN RECEIVING DIAMOND POLISHED FINISH

- A. Concrete receiving diamond polished finish shall be placed by ready mix truck, concrete conveyor, or motorized buggy in a single placement. Initial strike off of the concrete shall be performed with an approved ride on laser screed. Hand held vibrating screeds (with or without laser control) shall not be permitted.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: (For formed concrete surfaces not exposed to view) As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: (For formed concrete surfaces exposed to view) As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Unless noted otherwise, all exposed concrete surfaces shall receive a rubbed finish. Consult with Project Architect to determine the type of rubbed finish prior to pouring of concrete. Apply one of the following to smooth-formed finished as-cast concrete as indicated or directed by Architect:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General:

1. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
2. See architectural drawings for slab finish requirements or consult the Project Architect if finishes have not been supplied on the architectural drawings.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.

1. Apply scratch finish to surfaces to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated, to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated, exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - a. Finish surfaces to the following tolerances, see structural drawings

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
2. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistant aggregate.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread dampened slip-resistive aggregate over surface in 1 or 2 applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistant aggregate.

3.12 FINISHING INTERIOR FLOOR SLABS TO RECEIVE DIAMOND POLISHING

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by power-driven bowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance.
 - 1. Apply a machine trowel finish to surfaces to be polished.
 - a. Specified overall values of flatness, F(F) 50; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 17; for slabs-on-grade.
 - b. Troweling of floor receiving diamond polish shall be done using plastic finish blades to ensure the slab is not blackened. Blackening of the slab shall not be permitted.
 - c. Walking on the slab without wearing Finishing Slicks, Shoe Ins or walking on knee boards shall not be permitted.
 - d. The application of water during finishing shall be prohibited.
 - e. Edges shall receive a machine finish with either ride on bowels or walk behind edge machines. Hand finishing of edges is prohibited.

3.13 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.14 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.15 CONCRETE PROTECTING AND CURING FOR DIAMOND POLISHED CONCRETE

- A. Slabs to be diamond polished shall be water cured for a minimum of seven days.
- B. Protection: Slabs to be polished shall not receive permanent protection. Localized protection in the form of temporarily placed tarps, Ram Board can be used. All protection of slabs to be polished shall be removed at the end of each day's work.
- C. No eating or drinking on slabs to be polished shall be permitted.
- D. Storage: Storing materials on slab to be polished shall not be permitted.

3.16 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints, unless noted otherwise in documents. Overfill joint and trim joint filler flush with top of joint after hardening.

3.17 LIQUID FLOOR TREATMENTS, FOR DIAMOND POLISHED CONCRETE

- A. Performed per section 033543

3.18 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 - 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.19 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Provide special inspections in accordance with Chapter 17 of the International Building Code for concrete construction.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Headed bolts and studs.
 - 3. Verification of use of required design mixture.
 - 4. Mixing and delivery time for concrete.
 - a. Record the time batched, time arrived, and the time unloaded for each batch of concrete.
 - 5. Concrete placement, including conveying and depositing.
 - 6. Curing procedures and maintenance of curing temperature.
 - 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C 143/C 143M; one test at point of discharge for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change or is questionable.
 - a. Determine initial slump prior to any water addition to concrete at Project site and before any significant concrete discharge.
 - b. Measure and record water added to concrete on Project site and resulting slump.
 - c. Record amount of water indicated on batch ticket allowed to be added.
 - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 - 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 6. Compression Test Specimens: ASTM C 31/C 31M.

- a. Cast and laboratory cure five standard cylinder specimens for each composite sample.
 - b. Testing Agency shall be responsible for providing curing container for composite samples on Site as required for initial curing period and verifying that standard-cured composite samples are cured in accordance with ASTM C31/C31M. Testing Agency shall document method of initial curing.
 - c. The Contractor shall provide secured space, electrical power, and access for initial curing of test specimens.
7. Compressive-Strength Tests: ASTM C 39/C 39M.
- a. Test one specimen at 7 days, three specimens at 28 days, and hold one specimen for testing at 56 days, if necessary.
 - b. A compressive-strength test shall be the average compressive strength from a set of three specimens obtained from same composite sample and tested at age indicated.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work (illustrated via highlighting of elements on structural plans), design compressive strength at 28 days, concrete mixture proportions and materials, concrete unit weight, compressive breaking strength, and type of break for both 7- and 28-day tests. Deviations from the requirements of the Contract Documents shall be clearly identified and described on the reports.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness, per requirements on drawings, according to ASTM E 1155 within 72 hours of finishing.

END OF SECTION 033000

SECTION 033543 - POLISHED CONCRETE FINISHING

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. Polished concrete finishing.

B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for concrete slabs which may, or may not, be designated for a polished finish.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Material Certificates: For each of the following, signed by manufacturers:

- 1. Repair materials.
- 2. Liquid floor treatments.

1.5 QUALITY ASSURANCE

- A. Pre-Installation conference will be required prior to Foundation Pour. Concrete Supplier and Concrete Finisher shall be present to ensure there are no issues with compatibility in techniques.

- B. Mockups: Create mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Create mockups to comply with the following requirements, using materials indicated for the completed Work:

- 1. Provide two (2) mockups; one for newly placed concrete, and one for existing concrete, located in areas where floor coverings will be placed, and mockups will be concealed at end of project.
- 2. Demonstrate curing, finishing, and protecting of polished concrete.

1.6 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 – PRODUCTS

2.1 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas; PC 50 Lithium Densifier
 - b. Euclid Chemical Company (The); an RPM company; Euco Diamond Hard.
 - c. H&C Decorative Concrete Products; a brand of Sherwin-Williams Co.;
ENDURAPOLISH Clear Liquid Hardener & Densifier.
 - d. Laticrete International, Inc.; FGS Hardener Plus
 - e. MAPEI Corporation; Mapecrete Hard Li
 - f. PROSOCO, Inc; Consolideck LS.
 - g. Sika Corporation, SCOFIELD Formula One Lithium Densifier MP
 - h. Vexcon Chemicals Inc.; Certi-Shine Clear

PART 3 – EXECUTION

3.1 POLISHING

A. Polish: Level 3: High sheen, 800 grit.

B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.

1. Machine grind floor surfaces to receive polished finishes level and smooth, and to depth required to produce a Grade 2 “Salt & Pepper Finish”, exposing a spattering of aggregate in the concrete floor, giving the appearance of an aged surface.
2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
3. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
4. Control and dispose of waste products produced by grinding and polishing operations.
5. Neutralize and clean polished floor surfaces.

END OF SECTION 033543

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Architectural Concrete Unit Masonry requirements, installation, and execution

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product. For masonry units, include data on material properties and material test reports substantiating compliance with requirements.
- B. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1.4 QUALITY ASSURANCE

- A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1.5 FIELD CONDITIONS

- A. Cold-Weather Requirements: 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. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. 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.

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2.2 ARCHITECTURAL CONCRETE UNIT MASONRY (RE: SECTION 04 22 23)

2.3 MORTAR AND GROUT 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.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Cement Products: Packaged blend made from portland cement and hydrated lime, all complying with specified requirements, and containing no other ingredients.
 - 1. Portland Cement-Lime Mix:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Holcim (US) Inc.
 - 2) Lafarge North America Inc.
 - 3) Lehigh Hanson; HeidelbergCement Group.
- D. Aggregate for Mortar: ASTM C 144.
 - 1. Mortar Aggregates: Natural sand or crushed stone.
- E. 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.
- F. Water: Potable.

2.4 REINFORCEMENT

- A. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
 - 1. Exterior Walls: Hot-dip galvanized carbon steel.
 - 2. Wire Size for Veneer Ties: 0.187-inch (4.76-mm) diameter.

2.5 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
 - 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M, hot-dip galvanized.
- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized-steel wire.

2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized-steel wire.

D. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf (445-N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.5 mm).
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch- (1.90-mm-) thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a gasketed sheet metal anchor section, with pronged legs of length needed and raised rib-stiffened strap to provide a slot for inserting wire tie.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hohmann & Barnard, Inc.
 - 2) Wire-Bond.
5. Coated, Steel Drill Screws for Steel Studs or Metal Siding: ASTM C 954 except with hex washer head and neoprene or EPDM washer, No. 10 (4.83-mm) diameter, and with coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B 117.

2.6 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 7-oz./sq. ft. (2-kg/sq. m) copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Advanced Building Products Inc.
 - 2) Hohmann & Barnard, Inc.
2. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch (0.8 mm).
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) DuPont Building Innovations: E. I. du Pont de Nemours and Company.
 - 2) Grace Construction Products; W.R. Grace & Co. -- Conn.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or urethane.

B. Weep/Cavity Vent Products: Use one of the following unless otherwise indicated:

1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.
 - a. Provide Mortar Net USA, Ltd; Mortar Net Weep Vents.

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

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1. Configuration: Provide one of the following:
 - a. Sheets or strips not less than 3/4 inch (19 mm) thick and 10" high designed to catch mortar droppings and prevent weep holes from clogging with mortar.

2.8 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
 - b. PROSOCO, Inc.

2.9 MORTAR AND GROUT 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. For exterior masonry, use portland cement-lime mortar.
- 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: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 1. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. 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.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of textures.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.2 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.

C. Joints:

1. 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).
2. 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).
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.3 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. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay solid masonry units and brick with completely filled bed and head joints; butter ends with sufficient mortar to completely fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

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- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.5 MASONRY VENEER

- A. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

3.6 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
 1. Fasten screw-attached anchors to metal siding or wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 2. Embed tie sections in masonry joints.
 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 4. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 16 inches (458 mm) o.c. horizontally, with not less than one anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.

3.7 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 inch (25 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.
 3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 16 inches (458 mm) o.c. horizontally.

3.8 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.
- 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 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.
 3. 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.

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- C. 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.
 - 2. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.
 - 3. Cover cavity side of weep holes with plastic insect screening.
- D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- E. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

3.9 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. 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.
 - 3. Protect adjacent surfaces from contact with cleaner.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.10 MASONRY WASTE DISPOSAL

- A. 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 042000

SECTION 042223 - ARCHITECTURAL CONCRETE UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Ground face veneer concrete masonry units with clear acrylic sealant

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 07 62 00 – Sheet Metal Flashing and Trim

1.3 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 C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry.

1.4 DEFINITIONS

- A. CMU: Concrete Masonry Unit.
- B. Dimensions: All unit sizes are shown as Nominal Dimensions.

1.5 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.

1.6 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".

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- a. Provide elevations indicating steel reinforcing bar placement.
 - b. 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 60 inches x 60 inches.
 - 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.

1.7 CLOSEOUT SUBMITTALS

- A. Spare Materials: Provide spare Concrete Masonry Units of each color and finish combination used on the project.
- 1. 5 % spare units for each color and finish combination.
 - 2. Provide spare materials as noted in the schedule related to work in this section.

1.8 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.

1.9 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: 10 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: Echelon, An Oldcastle Company.
- 1. Address: 3 Glenlake Pkwy, FL 12, Atlanta, GA 30328.
 - 2. Phone: (844) 495-8211.
 - 3. Website: www.echelonmasonry.com.
- B. Provide products meeting the requirements specified in this section, from one of the following manufacturers:
Echelon Masonry "Trendstone" Ground Face CMU or approved equal
- C. 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:

2.2 PERFORMANCE REQUIREMENTS

- A. Freeze-Thaw Resistance: Meet or exceed the requirements of ASTM C1262.

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- B. Abrasion Resistance: Meet or exceed the requirements of ASTM C744.
- C. Adhesion: Meet or exceed the requirements of ASTM C744.
- D. Color Change: Meet or exceed the requirements of ASTM C744.
- E. Resistance to Crazeing: Meet or exceed the requirements of ASTM C744.
- F. Fire Resistance: Rated up to (4) four hours.
- G. Integral Water Repellant: Concrete Masonry Units must include an integral water repellant admixture at the time of production.

2.3 CONCRETE MASONRY UNITS

- A. General / Appearance: 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: Trendstone® concrete masonry units, from Echelon.

2.4 FINISHES

- A. Color:
 - 1. As selected from manufacturers full color range.
 - 2. Provide physical samples to the architect for final approval
- B. Dimensions:
 - 1. CMU (WxH): 3 9/16" inches x 7 9/16" inches x 15 5/8" inches. Locations and installation pattern as noted in the Contract Drawings.

2.5 MORTAR

- A. Provide pre-blended mortar that meets or exceeds the requirements of ASTM C1714/C1714M Type N.
- B. Mortar must include manufacturer approved compatible integral water repellent additive added to each batch in the dosage rates for mortar type specified.

2.6 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
 - a. Basis of Design Product: RainBloc® Water Repellent Masonry Unit admixture, manufactured by ACM Chemistries, Inc.
- F. Water: Potable; Clean and drinkable.

2.7 ACCESSORIES

- A. Provide coordinating accessory stones as necessary to achieve a complete installation as noted in the Contract Drawings.

PART 3 EXECUTION

3.1 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, Concrete Masonry Veneers, and Concrete Thin 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.

3.2 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.

3.3 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. 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.
- C. Mortar Bedding and Jointing:
 - 1. 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.
 - 2. Tool all joints into a concave configuration when mortar is thumbprint hard.
 - 3. Remove mortar from the face of masonry units before it sets.
 - 4. Tuckpoint joints of scored units for proper appearance and to prevent water penetration. Rake joints are not permitted and will be considered defective work.
- D. 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.

- E. 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.

3.4 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.

3.5 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 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Structural steel.
 - 2. Field-installed shear connectors.
 - 3. Grout.
- B. Related Requirements:
 - 1. Division 05 Section "Steel Decking" for field installation of shear connectors through deck.
 - 2. Division 05 Section "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
 - 3. Division 05 Section "Metal Stairs."
 - 4. Division 09 painting Sections for surface preparation and priming requirements.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
- C. The general contractor is responsible for coordinating the structural steel shop drawing submittal with all other submittals for elements which attach to structural steel or have an effect on structural steel design or detailing. This includes, but is not limited to, elevators, mechanical/electrical equipment, steel joists, pre-engineered metal stairs, railings, suspended partitions, sliding doors, suspended lights, glass storefront/curtainwall, roof davits, roll-up doors, guy wire supports, etc. Hold shop drawing production, ordering of material, fabrication, and other work associated with such elements as required until these other submittals are reviewed and approved. Provide separate submittals

for these elements as required. Elevator steel shall be provided in a separate submittal. The general contractor shall coordinate between steel supplier and these other suppliers as required.

1.5 PREINSTALLATION CONFERENCE

- A. Preinstallation Conference: Conduct conference at Project site (with video teleconferencing capabilities).

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Show fabrication of structural-steel components.

1. Include erection plans, sections, elevations, and details.
2. Include details of cuts, connections, splices, camber, holes, and other pertinent data. Provide details of all non-standard connections not specifically indicated on the drawings for approval. Comply with all AISC minimum edge distance and spacing requirements.
3. Include embedment Drawings.
4. Include exact layout of all kicker braces which attach to open-web steel bar joists.
5. Indicate size, material specification, surface preparation and coating for all members and components.
6. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds when backing bars are to remain. Provide welding process and joint designation for all complete-joint-penetration and partial-joint-penetration welds.
7. All required field welding shall be indicated on the erection drawings using erection details.
8. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
9. All column piece drawings shall indicate the grid location of the column.
10. Reproductions made from contract drawings will not be accepted.
11. For structural-steel connections indicated to comply with design loads, include structural analysis data by the qualified professional engineer responsible for their preparation.
12. Shop drawings shall be computer generated using three-dimensional detailing software.
13. **The final three-dimensional model shall be transmitted electronically to the Engineer along with submittal of shop drawings. Model is provided for information only. All comments from review will be made on 2D shop drawings. The three-dimensional model shall be submitted in IFC (.ifc) format. A three-dimensional model shall also be sent for all pre-engineered metal stairs.**
14. Allow 21 days for review of structural steel shop drawings, excluding delivery time to and from the contractor.
15. On projects where submittals are processed electronically, provide Engineer with a minimum of one half-sized copy of shop drawings for office use only.

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16. For shop drawings that are marked "Make Corrections Noted", provide Architect/Engineer with an electronic record set of the shop drawings and three-dimensional model for informational purposes once all revisions are made.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code – Steel," for each welded joint qualified by testing, including the following:

1. Power Source.

1.7 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Qualification Data: For Installer and fabricator.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with top coats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.

2. Direct-tension indicators.

3. Tension-control, high-strength bolt-nut-washer assemblies.

4. Shear stud connectors.

5. Shop primers.

6. Nonshrink grout.

F. Source quality-control test reports.

G. Survey of existing conditions.

H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

B. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.

2. AISC 360.

3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

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1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repacking and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturer's written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M or ASTM A 572/A 572M, Grade 50.
- B. Channels, Angles-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Corrosion-Resisting Structural Steel: ASTM A 588/A 588M, Grade 50.
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade C, structural tubing.
- F. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A 847, structural tubing.
- G. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 - 1. Weight Class: Standard, unless otherwise noted on drawings.
 - 2. Finish: Black, except where indicated to be galvanized.
- H. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirements S11.
- I. Steel Forgings: ASTM A 668/A 668M.
- J. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852 (also referred to as ASTM A 325 Tension-Control), Type 1, heavy hex head steel structural bolts with splined ends; ASTM A 563, Grade C (or Grade

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DH if indicated to be galvanized) heavy hex carbon-steel nuts; and ASTM F 436, Type 1 hardened carbon-steel washers.

1. Finish: Plain, except where indicated to be galvanized.
- B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- C. Threaded and Nuted Anchor Rods (or Anchor Bolts): ASTM F 1554, Grade 55, weldable, straight.
1. Nuts: ASTM A 563 heavy hex carbon steel.
 2. Plate Washers: ASTM A 36 carbon steel.
 3. Washers: ASTM F 436 hardened carbon steel.
 4. Finish: Plain, except where indicated to be galvanized.
- D. Threaded Rods: ASTM A 36
1. Nuts: ASTM A 563 heavy hex carbon steel.
 2. Washers: ASTM A 36 carbon steel.
 3. Finish: Plain, except where indicated to be galvanized.
- E. Clevises: ASTM A 668, Class A.
1. Clevis Pins: ASTM A108, Grade 1117.
 2. Dimensioning of clevises shall be in accordance with Table 15-4 of the AISC Steel Construction Manual, unless noted otherwise.
- F. Turnbuckles: ASTM F 1145, Type 1, Grade 1, Class B.
1. Dimensioning of turnbuckles shall be in accordance with Table 15-6 of the AISC Steel Construction Manual, unless noted otherwise.
- G. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.
- H. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.
- 2.3 PRIMER
- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
 - B. Primer: SSPC-Paint 25, zinc oxide, alkyd, linseed oil primer.
 - C. Primer chosen shall be compatible with any additional coatings required.
 - D. For exposed structural steel, refer to Division 09 sections
 - E. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 or ASTM A 780.

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1. Dry film shall have at least 94% metallic zinc by weight
2. Coordinate with Division 09 Sections of field painting if exposed.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- B. All grout shall have a minimum compressive strength of 7,000 psi at 28 days and a minimum compressive strength of 2,000 psi at 48 hours, per ASTM C109. All grout shall have height change (plastic state) range of 1% to 4% per ASTM C827.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303 "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 1. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 2. Mark and match-mark materials for field assembly.
 3. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces. Do not thermally cut bolt holes in the field or enlarge holes by burning.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 1. Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes in the field or enlarge holes by burning.
 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
- H. All clevises and turnbuckles shall be manufactured to meet the dimensions and load ratings shown in the AISC Steel Construction Manual.

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- I. All reinforcing bars to be welded to structural steel shall be ASTM A706, deformed, and fabricated in accordance with CRSI's "Manual of Standard Practice."

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Pretensioned.
 2. Use standard bolt holes. Slotted holes are not permitted unless indicated.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth for architecturally exposed structural steel members
 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC 303 for mill material.
 3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
 4. All flare bevel groove welds shall be filled flush with top of round surface, unless noted otherwise.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches. This does not apply to columns.
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials. This does not apply to intumescent coatings.
 5. Galvanized surfaces.
 6. Top flanges of composite steel beams that are specified to have headed shear studs attached.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 1. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Prepare steel and apply a 1-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).
- E. All structural steel shall be prepared in manner compatible with architectural requirements such as intumescent coatings, applied fire-proofing, high performance coatings, etc. Coordinate to verify compatibility between products chosen and/or methods of preparation. Identify any conflicts to Architect prior to fabrication of structural steel.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.
1. Fill vent holes and grind smooth after galvanizing.
 2. Galvanize steel lintels and shelf angles attached to structural frame and located in exterior walls.
 3. Galvanize steel exposed to weather, U.N.O.
 4. Galvanize all other steel specifically indicated on Drawings.
 5. Galvanize all anchor bolt assemblies for steel members outside building enclosure.
 6. Galvanized anchors and nuts shall be purchased from same supplier and shall be shipped preassembled.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1 and the following inspection procedures, at testing agency's option:
1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 3. Ultrasonic Inspection: ASTM E 164.

4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 2. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 3. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

4. All grout shall be placed under steel column base plates and achieve 70% of its required 28-day strength prior to placement of concrete for elevated floors which are supported by the steel columns.
 5. Grout shall be placed with fluid consistency if column blockouts are used at ground floor slab.
- C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection.
- H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- I. Do not cut holes in structural steel framing unless indicated on structural drawings.
- J. Headed Stud Anchors: Prepare steel surfaces as recommended by manufacturer of headed stud anchors. Use automatic end welding of headed stud anchors according to AWS D1.1 and manufacturer's written instructions. Welding shall develop full capacity of headed stud anchor.
- K. All structural steel diagonal brace members shall be set and attached to the steel frame prior to placement of concrete for elevated floors.
- L. Remove all factory piece markings (especially if welded on to the member) by grinding smooth on all elements to be exposed prior to field painting.
- M. All loose lintels supporting masonry or stone veneer shall be set such that the veneer has a minimum bearing width of 2-1/2 inches. Coordinate lintel placement with Architect at head of door/windows with veneer above.
- N. For members which provide shelf support of masonry or stone veneer, verify accuracy of alignment and elevation prior to permanently fastening. Contact Architect/Engineer if field adjustments to connections of members are required to accommodate tolerances.
- 3.4 FIELD CONNECTIONS
- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Pretensioned

2. Provide and install a tension-control, high-strength bolt-nut-washer assembly for all bolts on field bolted connections.
 3. Use standard bolt holes. Slotted holes are not permitted unless indicated.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
1. Comply with AISC 303 and AISC 360 for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth for architecturally exposed structural steel connections.
 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC 303, "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
 5. All flare bevel groove welds shall be filled flush with top of round surface, unless noted otherwise.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Verify structural-steel materials and inspect steel frame joint details.
 2. Verify weld materials and inspect welds.
 3. Verify connection materials and inspect high-strength bolted connections.
 4. Verify all other applicable items as required per Chapter N of AISC 360.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspection.
- C. All inspection and tests shall be performed in accordance with Chapter N of AISC 360.
- D. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Welded Connections: Visually inspect field welds according to AWS D1.1. See structural drawings for additional requirements on weld inspection.
1. In addition to visual inspection, test and inspect field welds according to AWS D1.1 and the following inspection procedures, at testing agency's option or as specified on structural drawings:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.

- F. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- G. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
 - 1. All corrections shall be submitted to the Project Architect and Engineer for review and approval. Correction work shall not proceed until approval has been provided.
 - 2. Significant deficiencies in construction which require substantial engineering to resolve may require the contractor to secure the services of a professional engineer at no additional cost to the owner. The Project Architect and/or Engineer of Record will determine if a contractor hired engineer is required depending on the severity of the deficiency and the extent of work involved.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780 and manufacturer's written instructions.
- B. Touchup Priming: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Remove all factory piece markings (especially if welded on to the member) by grinding smooth on all elements to be exposed prior to field touchup priming operations. Touchup prime all repaired spots that required field grinding and cleanup which damaged the shop priming.
- C. Touchup Painting: Cleaning and touchup painting for exposed steel are specified in Division 09 painting Sections.

3.7 MISCELLANEOUS STEEL

- A. Unless otherwise indicated on the structural drawings, provide angles, tubes, plates, channels, and other steel members shown on the architectural and connect with 1/4" fillet weld at all material interfaces. Unless otherwise indicated, the following assumptions shall be made regarding spacing and member size in order to establish an all-inclusive structural steel bid price. Plates-5/16", Cont. Bent Plate- 5/16", Angle-L5x5x3/8, Channel Horizontally Oriented- C12x30, Channel Vertically Oriented-C6x8.2, Wide Flange-W18x35, Tube-HSS 6x6x5/16. Members/pieces shown in section shall be assumed continuous unless otherwise noted. Spacing intervals of stiffeners, hangers, kickers, -30"OC. Columns W12x79." It is the contractor's responsibility to coordinate and verify all structural steel shapes indicated in architectural drawings, prior to bid.

END OF SECTION 051200

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Structural steel.
 - 2. Field-installed shear connectors.
 - 3. Grout.
- B. Related Requirements:
 - 1. Division 05 Section "Steel Decking" for field installation of shear connectors through deck.
 - 2. Division 05 Section "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
 - 3. Division 05 Section "Metal Stairs."
 - 4. Division 09 painting Sections for surface preparation and priming requirements.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
- C. The general contractor is responsible for coordinating the structural steel shop drawing submittal with all other submittals for elements which attach to structural steel or have an effect on structural steel design or detailing. This includes, but is not limited to, elevators, mechanical/electrical equipment, steel joists, pre-engineered metal stairs, railings, suspended partitions, sliding doors, suspended lights, glass storefront/curtainwall, roof davits, roll-up doors, guy wire supports, etc. Hold shop drawing production, ordering of material, fabrication, and other work associated with such elements as required until these other submittals are reviewed and approved. Provide separate submittals

for these elements as required. Elevator steel shall be provided in a separate submittal. The general contractor shall coordinate between steel supplier and these other suppliers as required.

1.5 PREINSTALLATION CONFERENCE

- A. Preinstallation Conference: Conduct conference at Project site (with video teleconferencing capabilities).

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Show fabrication of structural-steel components.

1. Include erection plans, sections, elevations, and details.
2. Include details of cuts, connections, splices, camber, holes, and other pertinent data. Provide details of all non-standard connections not specifically indicated on the drawings for approval. Comply with all AISC minimum edge distance and spacing requirements.
3. Include embedment Drawings.
4. Include exact layout of all kicker braces which attach to open-web steel bar joists.
5. Indicate size, material specification, surface preparation and coating for all members and components.
6. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds when backing bars are to remain. Provide welding process and joint designation for all complete-joint-penetration and partial-joint-penetration welds.
7. All required field welding shall be indicated on the erection drawings using erection details.
8. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
9. All column piece drawings shall indicate the grid location of the column.
10. Reproductions made from contract drawings will not be accepted.
11. For structural-steel connections indicated to comply with design loads, include structural analysis data by the qualified professional engineer responsible for their preparation.
12. Shop drawings shall be computer generated using three-dimensional detailing software.
13. **The final three-dimensional model shall be transmitted electronically to the Engineer along with submittal of shop drawings. Model is provided for information only. All comments from review will be made on 2D shop drawings. The three-dimensional model shall be submitted in IFC (.ifc) format. A three-dimensional model shall also be sent for all pre-engineered metal stairs.**
14. Allow 21 days for review of structural steel shop drawings, excluding delivery time to and from the contractor.
15. On projects where submittals are processed electronically, provide Engineer with a minimum of one half-sized copy of shop drawings for office use only.

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16. For shop drawings that are marked "Make Corrections Noted", provide Architect/Engineer with an electronic record set of the shop drawings and three-dimensional model for informational purposes once all revisions are made.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code – Steel," for each welded joint qualified by testing, including the following:

1. Power Source.

1.7 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Qualification Data: For Installer and fabricator.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with top coats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.

2. Direct-tension indicators.

3. Tension-control, high-strength bolt-nut-washer assemblies.

4. Shear stud connectors.

5. Shop primers.

6. Nonshrink grout.

F. Source quality-control test reports.

G. Survey of existing conditions.

H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

B. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.

2. AISC 360.

3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

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1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repacking and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturer's written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M or ASTM A 572/A 572M, Grade 50.
- B. Channels, Angles-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Corrosion-Resisting Structural Steel: ASTM A 588/A 588M, Grade 50.
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade C, structural tubing.
- F. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A 847, structural tubing.
- G. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 - 1. Weight Class: Standard, unless otherwise noted on drawings.
 - 2. Finish: Black, except where indicated to be galvanized.
- H. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirements S11.
- I. Steel Forgings: ASTM A 668/A 668M.
- J. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852 (also referred to as ASTM A 325 Tension-Control), Type 1, heavy hex head steel structural bolts with splined ends; ASTM A 563, Grade C (or Grade

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DH if indicated to be galvanized) heavy hex carbon-steel nuts; and ASTM F 436, Type 1 hardened carbon-steel washers.

1. Finish: Plain, except where indicated to be galvanized.
- B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- C. Threaded and Nuted Anchor Rods (or Anchor Bolts): ASTM F 1554, Grade 55, weldable, straight.
1. Nuts: ASTM A 563 heavy hex carbon steel.
 2. Plate Washers: ASTM A 36 carbon steel.
 3. Washers: ASTM F 436 hardened carbon steel.
 4. Finish: Plain, except where indicated to be galvanized.
- D. Threaded Rods: ASTM A 36
1. Nuts: ASTM A 563 heavy hex carbon steel.
 2. Washers: ASTM A 36 carbon steel.
 3. Finish: Plain, except where indicated to be galvanized.
- E. Clevises: ASTM A 668, Class A.
1. Clevis Pins: ASTM A108, Grade 1117.
 2. Dimensioning of clevises shall be in accordance with Table 15-4 of the AISC Steel Construction Manual, unless noted otherwise.
- F. Turnbuckles: ASTM F 1145, Type 1, Grade 1, Class B.
1. Dimensioning of turnbuckles shall be in accordance with Table 15-6 of the AISC Steel Construction Manual, unless noted otherwise.
- G. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.
- H. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.
- 2.3 PRIMER
- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
 - B. Primer: SSPC-Paint 25, zinc oxide, alkyd, linseed oil primer.
 - C. Primer chosen shall be compatible with any additional coatings required.
 - D. For exposed structural steel, refer to Division 09 sections
 - E. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 or ASTM A 780.

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1. Dry film shall have at least 94% metallic zinc by weight
2. Coordinate with Division 09 Sections of field painting if exposed.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- B. All grout shall have a minimum compressive strength of 7,000 psi at 28 days and a minimum compressive strength of 2,000 psi at 48 hours, per ASTM C109. All grout shall have height change (plastic state) range of 1% to 4% per ASTM C827.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303 "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 1. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 2. Mark and match-mark materials for field assembly.
 3. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces. Do not thermally cut bolt holes in the field or enlarge holes by burning.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 1. Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes in the field or enlarge holes by burning.
 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
- H. All clevises and turnbuckles shall be manufactured to meet the dimensions and load ratings shown in the AISC Steel Construction Manual.

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- I. All reinforcing bars to be welded to structural steel shall be ASTM A706, deformed, and fabricated in accordance with CRSI's "Manual of Standard Practice."

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Pretensioned.
 2. Use standard bolt holes. Slotted holes are not permitted unless indicated.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth for architecturally exposed structural steel members
 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC 303 for mill material.
 3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
 4. All flare bevel groove welds shall be filled flush with top of round surface, unless noted otherwise.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches. This does not apply to columns.
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials. This does not apply to intumescent coatings.
 5. Galvanized surfaces.
 6. Top flanges of composite steel beams that are specified to have headed shear studs attached.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 1. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Prepare steel and apply a 1-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).
- E. All structural steel shall be prepared in manner compatible with architectural requirements such as intumescent coatings, applied fire-proofing, high performance coatings, etc. Coordinate to verify compatibility between products chosen and/or methods of preparation. Identify any conflicts to Architect prior to fabrication of structural steel.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.
1. Fill vent holes and grind smooth after galvanizing.
 2. Galvanize steel lintels and shelf angles attached to structural frame and located in exterior walls.
 3. Galvanize steel exposed to weather, U.N.O.
 4. Galvanize all other steel specifically indicated on Drawings.
 5. Galvanize all anchor bolt assemblies for steel members outside building enclosure.
 6. Galvanized anchors and nuts shall be purchased from same supplier and shall be shipped preassembled.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1 and the following inspection procedures, at testing agency's option:
1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 3. Ultrasonic Inspection: ASTM E 164.

4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 2. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 3. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

4. All grout shall be placed under steel column base plates and achieve 70% of its required 28-day strength prior to placement of concrete for elevated floors which are supported by the steel columns.
 5. Grout shall be placed with fluid consistency if column blockouts are used at ground floor slab.
- C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection.
- H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- I. Do not cut holes in structural steel framing unless indicated on structural drawings.
- J. Headed Stud Anchors: Prepare steel surfaces as recommended by manufacturer of headed stud anchors. Use automatic end welding of headed stud anchors according to AWS D1.1 and manufacturer's written instructions. Welding shall develop full capacity of headed stud anchor.
- K. All structural steel diagonal brace members shall be set and attached to the steel frame prior to placement of concrete for elevated floors.
- L. Remove all factory piece markings (especially if welded on to the member) by grinding smooth on all elements to be exposed prior to field painting.
- M. All loose lintels supporting masonry or stone veneer shall be set such that the veneer has a minimum bearing width of 2-1/2 inches. Coordinate lintel placement with Architect at head of door/windows with veneer above.
- N. For members which provide shelf support of masonry or stone veneer, verify accuracy of alignment and elevation prior to permanently fastening. Contact Architect/Engineer if field adjustments to connections of members are required to accommodate tolerances.
- 3.4 FIELD CONNECTIONS
- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Pretensioned

2. Provide and install a tension-control, high-strength bolt-nut-washer assembly for all bolts on field bolted connections.
 3. Use standard bolt holes. Slotted holes are not permitted unless indicated.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
1. Comply with AISC 303 and AISC 360 for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth for architecturally exposed structural steel connections.
 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC 303, "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
 5. All flare bevel groove welds shall be filled flush with top of round surface, unless noted otherwise.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Verify structural-steel materials and inspect steel frame joint details.
 2. Verify weld materials and inspect welds.
 3. Verify connection materials and inspect high-strength bolted connections.
 4. Verify all other applicable items as required per Chapter N of AISC 360.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspection.
- C. All inspection and tests shall be performed in accordance with Chapter N of AISC 360.
- D. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Welded Connections: Visually inspect field welds according to AWS D1.1. See structural drawings for additional requirements on weld inspection.
1. In addition to visual inspection, test and inspect field welds according to AWS D1.1 and the following inspection procedures, at testing agency's option or as specified on structural drawings:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.

- F. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- G. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
 - 1. All corrections shall be submitted to the Project Architect and Engineer for review and approval. Correction work shall not proceed until approval has been provided.
 - 2. Significant deficiencies in construction which require substantial engineering to resolve may require the contractor to secure the services of a professional engineer at no additional cost to the owner. The Project Architect and/or Engineer of Record will determine if a contractor hired engineer is required depending on the severity of the deficiency and the extent of work involved.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780 and manufacturer's written instructions.
- B. Touchup Priming: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Remove all factory piece markings (especially if welded on to the member) by grinding smooth on all elements to be exposed prior to field touchup priming operations. Touchup prime all repaired spots that required field grinding and cleanup which damaged the shop priming.
- C. Touchup Painting: Cleaning and touchup painting for exposed steel are specified in Division 09 painting Sections.

3.7 MISCELLANEOUS STEEL

- A. Unless otherwise indicated on the structural drawings, provide angles, tubes, plates, channels, and other steel members shown on the architectural and connect with 1/4" fillet weld at all material interfaces. Unless otherwise indicated, the following assumptions shall be made regarding spacing and member size in order to establish an all-inclusive structural steel bid price. Plates-5/16", Cont. Bent Plate- 5/16", Angle-L5x5x3/8, Channel Horizontally Oriented- C12x30, Channel Vertically Oriented-C6x8.2, Wide Flange-W18x35, Tube-HSS 6x6x5/16. Members/pieces shown in section shall be assumed continuous unless otherwise noted. Spacing intervals of stiffeners, hangers, kickers, -30"OC. Columns W12x79." It is the contractor's responsibility to coordinate and verify all structural steel shapes indicated in architectural drawings, prior to bid.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

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 deck.
- 2. Composite floor deck.

B. Related Requirements:

- 1. Division 03 Section "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
- 2. Division 05 Section "Structural Steel" for shop- and field-welded shear connectors.
- 3. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
- 4. Division 09 painting Sections for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Reproductions made from contract drawings will not be accepted. Submit one (1) electronic print. Review of shop drawings by the Architect/Engineer will be for general compliance with contract documents.
 - 1. Include plans showing layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.

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- D. Evaluation Reports: For steel deck.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. 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.

2.2 ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Canam Steel Corporation.
 - 2. Epic Metals Corporation.
 - 3. New Millennium Building Systems, LLC.
 - 4. Nucor Corp.; Vulcraft Group. (design basis on structural plans)
 - 5. Valley Joist.
 - 6. DACS, Inc.
 - 7. Cordeck.
 - 8. Consolidated Systems, Inc.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Fasteners indicated on plans as "Tek Screws" shall be self-drilling tapping screws complying with the material, process, and performance requirements of ASTM C1513. Tek screws shall be corrosion resistant and meet the minimum requirements of ASTM F1941. Provide larger screws if required for attachment to structural steel. Provide screws penetrating joined members by not less than three exposed screw threads
- E. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- F. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- G. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.
- H. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- I. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- J. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- K. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- L. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- M. Galvanizing Repair Paint: ASTM A 780.
- N. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work. See structural drawings for 12 gage reinforcement plate required at small openings in the deck.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Deck fasteners shall be in accordance with structural contract drawings.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members as indicated on the plans.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels as indicated on the plans.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 4 inches apart with at least one fastener at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. mechanically fasten to substrate to provide a complete deck installation.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members as indicated on the plans.

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- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels as indicated on the plans.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum at non-composite deck. Butted at centerline of support at composite deck (1/2" maximum gap).
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
 - 1. Girder filler shall be provided on both sides of composite girder beams (spanning parallel to composite deck span) to ensure full concrete coverage over top flange of girder beam.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck. Continuous closure pieces shall be cut at deck valleys as deemed necessary by Engineer.
- F. Provide shoring of floor deck if indicated on Drawings.
- G. Weld stud shear connectors through steel deck to structural members below.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and inspections shall be performed in accordance with SDI-QA/QC "Standard for Quality Control and Quality Assurance for Installation of Steel Deck."
- C. Field welds will be subject to inspection.
- D. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- E. Remove and replace work that does not comply with specified requirements.
- F. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.
- G. Prior to placement of roofing material over metal roof deck, the Contractor shall notify Testing Agency to perform inspection of roof deck fastening to supporting elements. Roofing material shall not be placed until inspection results are reviewed by Architect and all corrective work is complete.

3.6 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 - 2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Division 09 Section.

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- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

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. Exterior non load-bearing wall framing (Delegated design. See Performance Requirements).
 - 2. Exterior soffit framing. (Delegated design. See Performance Requirements).
- B. This specification section applies to all references in the contract documents to specification section 05 41 00 as well as section 05 40 00.
- C. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
 - 2. Division 9 Section "Gypsum Board Assemblies" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads shown in plans and for resisting wind pressures determined from the wind speeds, exposure and risk category provided on plans.
 - 1. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non Load-Bearing Wall Framing: Horizontal deflection of 1/600 of the wall height for walls supporting brick/masonry veneer. Horizontal deflection of 1/360 of wall height for all other walls. Ultimate wind loads may be multiplied by 0.42 as allowed by IBC for purposes of wall deflection limits.
 - b. The above deflection limits apply at all spans of the framing member, including cantilever spans and overhangs.
 - 2. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
 - 3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 3/4 inch.

4. Design cold-formed framing systems to withstand any design loads and forces acting onto the cold-formed framing systems from any storefront/glass assemblies. Proper consideration of point loads from mullions shall be indicated in the design calculations.
 5. Design cold-formed framing systems to accommodate connections of any storefront/glass assemblies.
 6. All framing conditions which preclude the complete usage of cold-formed metal framing as indicated on the construction documents shall be identified prior to bidding or be resolved after bidding at no additional cost to the owner. Provide fixed connections to the structure where required for stability at cantilever conditions. Connections to structure shall be designed and provided by cold-formed metal framing supplier. Only provide fixed connections to structure when required for stability. Do not add kicker braces to reduce the span length of exterior wall studs. Do not attach to bottom flange of steel beams unless indicated on structural drawings.
 7. Design all exterior soffit ceilings to resist positive and negative wind pressure in accordance with ASCE 7. Design soffit framing for dead weight of soffit and for a vertical construction live load of 10 psf minimum and a simultaneous 300 pound point load where erector can stand and otherwise load such framing.
 8. Thickness of cold-formed metal framing shall be minimum required for anchorage at all louvers, doors, windows, and other wall openings. Coordinate with applicable supplier for minimum thickness of material for anchorage at framed wall openings.
 9. For ladders supported by cold-formed metal framing, the detailing of ladder connections to the cold-formed metal framing shall be clearly indicated on the shop drawings (general contractor shall coordinate loading and connection compatibility between ladder supplier and cold-formed metal stud supplier).
- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
 2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work. Layout for metal stud wall framing shall include building elevations and/or wall plans indicating applicable wall sections in shop drawings. Provide wall sections for all unique exterior wall framing conditions around perimeter of building, including applicable locations where sections have not been provided in contract drawings. Contact Architect/Engineer prior to submittal of Shop Drawings if any additional information is required.
1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Submit shop drawings, sealed and signed by a qualified Louisiana Registered Civil Engineer.
 - a. Shop drawings shall be computer generated using two-dimensional drafting software (minimum).
 - b. Shop drawings (and all other information necessary for field construction) shall be on completely separate sheets from structural analysis data (calculations).

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3. Allow 21 days for review of cold-formed metal framing shop drawings, excluding delivery time to and from the contractor.
 4. For shop drawings that are marked "Mark Corrections Noted", provide Architect/Engineer with an electronic record set of the shop drawings for informational purposes once all revisions are made.
 5. Do not submit shop drawings prior to review and approval of storefront/glass assembly submittals and pre-engineering metal building submittals.
- C. Welding certificates (if any welding is required).

1.5 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. 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 cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.
- E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
 2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
- I. The general contractor is responsible for coordinating with the cold-formed metal framing Design Engineer to ensure the metal framing is installed in accordance with the approved shop drawings. The Architect/Engineer is not responsible for verifying proper installation of cold-formed metal framing.
- J. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.

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1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing, not including pre-engineered roof trusses, by one of the following:
 - 1. AllSteel & Gypsum Products, Inc.
 - 2. California Expanded Metal Products Company.
 - 3. ClarkDietrich Building Systems
 - 4. Consolidated Fabricators Corp.; Building Products Division.
 - 5. Custom Stud, Inc.
 - 6. MarinoWare; a division of Ware Industries.
 - 7. SCAFCO Corporation.
 - 8. Steel Construction Systems.
 - 9. Steeler, Inc.
 - 10. United Metal Products, Inc.

2.2 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60, A60, AZ50, or GF30.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G90.
- C. Screws: All screws used in the manufacture of steel roof trusses shall be exterior rated zinc coated self-drilling screws.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: As required by design but in no case less than 0.0428 inch.
 2. Minimum Flange Width: 1-5/8 inches.
 3. Section Properties: As required by design. See drawings for required depth of wall.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: As required by design but in no case less than 0.0428.
 2. Minimum Flange Width: 1-1/4 inches.
 3. Section Properties: As required by design. See drawings for required depth of wall.
- C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
1. Minimum Base-Metal Thickness: As required by design but in no case less than 0.0428 inch.
 2. Flange Width: 1 inch plus the design gap for 1-story structures.
 3. Section Properties: As required by design. See drawings for required depth of wall.
- D. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: As required by design but in no case less than 0.0428 inch.
 - b. Minimum Flange Width: 1 inch plus twice the design gap.
 - c. Section Properties: As required by design. See drawings for required depth of wall.
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: As required by design but in no case less than 0.0428 inch.
 - b. Minimum Flange Width: width equal to the sum of outer deflection track flange width plus 1 inch.
 - c. Section Properties: As required by design. See drawings for required depth of wall.
- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

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1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel headless, hooked bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.
- B. Cement Grout (if required): Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout (if required): Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

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- D. Shims (if required): Load bearing, high-density multimonomer plastic, nonleaching.
- E. Sealer Gaskets (if required): Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.7 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
 - 4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 7 Section "Building Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

- K. Exterior Soffit Framing: Provide horizontal and vertical members as required for support of all exterior soffit ceilings. Vertical members shall be provided at all structural steel beam and open web steel joist locations to uniformly distribute weight and loading of soffit ceiling to structure above. Vertical members may attach to underside of composite-concrete metal decks where required and the attachments shall be made such that a line load is imposed perpendicular to the deck span direction. Vertical members shall not attach directly to non-composite concrete metal floor decks and metal roof decks. All attachments to open web steel joists shall be made at each panel point location. All kickers shall only be provided between metal stud framing member where required for stability and without interfering with other work or requirements indicated by the drawings. Kicker brace configurations shall not induce torsion or twisting into floor beams or joists and attachments shall be made for direct transfer of horizontal to floor or roof deck, where required for stability.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
 - 1. Maximum Stud Spacing: 16 inches, or as indicated.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. At Contractor's option, single or double deflection tracks may be used.
 - 2. Install single deflection track and attach to building structure.
 - 3. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 4. Connect drift clips to cold formed metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 72 inches apart. Fasten at each stud intersection.
 - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system. Provide miscellaneous framing and connections as required for support of all masonry veneer, cast stone bands, and other wall covering elements.

3.5 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 060573 - FIRE-RETARDANT TREATED WOOD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire-retardant treatment of lumber and plywood (FTRW).
 - 2. Fire retardant sheathing.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D3201 - Standard Test Method for Hydrosopic Properties of Fire-Retardant Wood and Wood-Base Products.
 - 2. ASTM D5516 - Standard Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures.
 - 3. ASTM D5664 - Standard Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber.
 - 4. ASTM D6305 - Standard Practice for Calculating Bending Strength Design Adjustment Factors for Fire Retardant Treat Plywood Roof Sheathing.
 - 5. ASTM D6841 - Standard Practice for Calculating Treatment Adjustment Factors for Fire Retardant Treated Lumber.
 - 6. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 7. ASTM 2768 - Extended Duration Surface Burning Characteristics of Building Materials.
 - 8. ASTM E119 - Fire Tests of Building Construction and Materials.
- B. American Wood-Protection Association (AWPA):
 - 1. AWPA E12 - Standard Method of Determining the Corrosion of Metal in contact with wood.
 - 2. AWPA M4 - Standard for Care of Preservative Treated Wood Products.
 - 3. AWPA P50 - Standard for Fire Retardant FR-2 (FR-2).
 - 4. AWPA T1 - Use Category System: Processing and Treatment Standard.
 - 5. AWPA U1 - Use Category System: User Specifications for Treated Wood.
- C. Intertek Code Compliance Research Report: CCRR-1088 - FlameTech Fire Retardant Treatment
- D. Intertek - ASTM E84/ASTM E2768 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. Intertek - ASTM E119 - Standard Test Method for Fire Testing of Building Construction and Materials.
- F. QAI - ASTM E84/ASTM E2768 - Standard Test Method for Surface Burning Characteristics of Building Materials

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:

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1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Fire-Retardant Treatment Certification: Treating plant's certification of compliance with specified requirements.

1.4 QUALITY ASSURANCE

A. Wood Treatment Plant Qualifications: Wood treatment plant experienced in performing work of this section licensed by Fire Retardant Chemical Technology.

B. Source Quality: Obtain treated wood products from a single approved source.

C. Fire-Retardant Treatment: Mark each piece of plywood and lumber to show Compliance with specified standards.

D. Regulatory Requirements: Provide for retardant treatment which complies with the following regulatory requirements:

1. 2021 International Building Code (IBC).

E. Independent Third-Party Inspection:

1. Provide plant inspections.

F. Kiln Dry after Treatment (KDAT): Provide kiln dry material as indicated or required.

1. Kiln dry after treatment to 19 percent maximum moisture content for lumber and 15 percent for plywood in accordance with AWPA T1, Section H - Subsection 3. Drying Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Exposure: Protect wood products against moisture and dimensional changes, in accordance with instructions from treating plant.

B. Avoid exposure to water and the elements, at the job site or in storage. If materials become wet during installation, allow lumber to dry to 19 percent and plywood to 15 percent moisture content before covering or enclosing.

C. Handling: Handle materials to avoid damage.

1.6 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 recommended limits.

1.7 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 WARRANTY

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- A. Manufacturer's Warranty: Provide manufacturer's standard 20-year limited warranty for pressure-treated FRTW wood.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Chicago Flameproof or Equal
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 MATERIALS

- A. Fasteners and Metal Hardware: Provide corrosion resistant steel fasteners with Hot-dip zinc coating per ASTM A153/A153M, provide corrosion resistant hardware per ASTM A653 / A653M Class G-185 in compliance with building code requirements.
- B. Fasteners Used with FlameTech Fire-Retardant Treated Wood: Fasteners must be galvanized steel, stainless steel, in accordance with 2021 IBC Section 2304.9.5, 2021 IRC Section R317.3 or 2021 IRC Section R319.3.

2.3 FIRE RETARDANT PRESSURE TREATMENT OF LUMBER AND PLYWOOD

- A. Fire retardant treatment for wood, including roof and floor trusses, roof decks and sheathing; subflooring, beams and purlins, blocking and furring, studs, joists and paneling, architectural millwork and trim, interior non-load bearing partitions, and exterior load-bearing wall.
 - 1. Plywood: Comply with AWPA U1, UCFA, Type A.
 - 2. Surface Burning Characteristics: Class A; or flame spread, and smoke developed ratings of 25 and 450 respective or less in a test of 30 minutes duration in accordance with IBC section 2303.2.
 - 3. Treatment: FlameTech FRT as manufactured by Fire Retardant Chemical Technology. (FRCT).
 - 4. Kiln dry after treatment of 19 percent maximum moisture content for lumber and 15 percent for plywood.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fire-Retardant Treated Wood:
 - 1. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.
 - 2. End cuts and drilling are permitted. Do not rip or mill lumber after fire-retardant treatment.

END OF SECTION 060573

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: ICC-ES evaluation reports for treated wood.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.

2.2 TREATED MATERIALS

- A. Preservative-Treated Materials: AWPA C2, except that lumber not in ground contact and not exposed to the weather may be treated according to AWPA C31 with inorganic boron (SBX).
 - 1. Use treatment containing no arsenic or chromium.
 - 2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
 - 3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- B. Provide preservative-treated materials for items indicated on Drawings, and the following:
 - 1. Wood members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Concealed members in contact with masonry or concrete.
- C. Fire-Retardant-Treated Materials: Comply with performance requirements in AWPA C20.
 - 1. Use Exterior type for exterior locations and where indicated.
 - 2. Use Interior Type A, High Temperature (HT) where indicated.
 - 3. Use Interior Type A unless otherwise indicated.
 - 4. Identify with appropriate classification marking of a testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Provide fire-retardant treated materials for items indicated on Drawings.

2.3 LUMBER

- A. Dimension Lumber:
 - 1. Maximum Moisture Content: 15 percent.
- B. Concealed Boards: Mixed southern pine, No. 2: SPIB with 15 percent maximum moisture content.
- C. Miscellaneous Lumber: Construction, or No. 2 grade with 15 percent maximum moisture content of any species. Provide for nailers, blocking, and similar members.

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2.4 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: Plywood, Exterior, AC, fire-retardant treated, not less than 3/4-inch nominal thickness.

2.5 FASTENERS

- A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
 - 1. Power-Driven Fasteners: CABO NER-272.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set miscellaneous rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Securely attach miscellaneous rough carpentry to substrates, complying with the following:
 - 1. CABO NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in the IBC".

END OF SECTION 06 10 53

SECTION 061643 - GYPSUM SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Fiberglass-mat faced, moisture and mold resistant gypsum sheathing.
- B. Related Sections:
 - 1. Section 05 41 00 Structural Metal Stud Framing.
 - 2. Section 06 10 00 Rough Carpentry.
 - 3. Section 09 21 16 Gypsum Board Assemblies.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.
 - 2. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 3. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - 4. ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - 5. ASTM C1280 Standard Specification for Application of Gypsum Sheathing.
 - 6. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - 7. ASTM D6329 Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers.
 - 8. ASTM E72 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
 - 9. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.
 - 10. ASTM C1396 Standard Specification for Gypsum Board
 - 11. ASTM E 136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C
 - 12. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
- B. Gypsum Association (GA): GA-253 Application of Gypsum Sheathing.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's specifications and installation instructions for each product specified.

1.4 WARRANTY

- A. Provide products that offer twelve months of coverage against in-place exposure damage (delamination, deterioration and decay) commencing with the date of installation of the product in such structure.
- B. Manufacturer's Warranty:

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1. Five years against manufacturing defects from the date of purchase of the product for installation
2. 12 years against manufacturing defects when used as a substrate in architecturally specified EIFS.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Georgia-Pacific Gypsum LLC:
 1. Fiberglass-Mat Faced Gypsum Sheathing: DensGlass Sheathing.
 2. Fiberglass-Mat Faced Gypsum Sheathing, Type X for Fire Rated Designs: DensGlass Fireguard Sheathing.
- B. Or prior approved equal.

2.2 MATERIALS

- A. Fiberglass-Mat Faced Gypsum Sheathing: ASTM C1177:
 1. Thickness: 5/8 inch.
 2. Width: 4 feet.
 3. Length: 8 feet.
 4. Weight: 1.9 lb/sq. ft.
 5. Edges: Square.
 6. Surfacing: Fiberglass mat on face, back, and long edges.
 7. Racking Strength (Ultimate, not design value) (ASTM E72): Not less than 540 pounds per square foot, dry.
 8. Flexural Strength, Parallel (ASTM C473): 80 lbf, parallel.
 9. Humidified Deflection (ASTM C1177): Not more than 2/8 inch.
 10. Permeance (ASTM E96): Not less than 23 perms.
 11. R-Value (ASTM C518): 0.56.
 12. Mold Resistance (ASTM D3273): 10, in a test as manufactured.
 13. Microbial Resistance (ASTM D6329, UL Environmental GREENGUARD 3-week protocol): Will not support microbial growth.
 14. Acceptable Products:
 - a. 5/8 inch DensGlass Sheathing, Georgia-Pacific Gypsum LLC.
 - b. Or prior approved equal.
- B. Fire-Rated Fiberglass-Mat Faced Gypsum Sheathing: ASTM C1177, Type X:
 1. Thickness: 5/8 inch.
 2. Width: 4 feet.
 3. Length: 8 feet
 4. Weight: 2.5 lb/sq. ft.
 5. Edges: Square.
 6. Surfacing: Fiberglass mat on face, back, and long edges.
 7. Racking Strength (Ultimate, not design value) (ASTM E72): Not less than 654 pounds per square foot, dry.
 8. Flexural Strength, Parallel (ASTM C1177): 100 lbf, parallel.
 9. Humidified Deflection (ASTM C1177): Not more than 1/8 inch.
 10. Permeance (ASTM E96): Not less than 17 perms.
 11. R-Value (ASTM C518): 0.67.
 12. Mold Resistance (ASTM D3273): 10, in a test as manufactured.

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13. Microbial Resistance (ASTM D6329, UL Environmental GREENGUARD 3-week protocol): Will not support microbial growth.
14. Acceptable Products:
 - a. 5/8 inch DensGlass Fireguard Sheathing, Georgia-Pacific Gypsum LLC.
 - b. Or prior approved equal.

2.3 ACCESSORIES

- A. Screws: ASTM C1002, corrosion resistant treated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 1. Inspection: Verify that project conditions and substrates are acceptable, to the installer, to begin installation of work of this section.

3.2 INSTALLATION

- A. General: In accordance with GA-253, ASTM C1280 and the manufacturer's recommendations.
 1. Manufacturer's Recommendations:
 - a. Current "Product Catalog", Georgia-Pacific Gypsum.
 - b. Or prior approved equal.

3.3 PROTECTION.

- A. Protect gypsum board installations from damage and deterioration until date of Substantial Completion.

END OF SECTION 061643

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data, Shop Drawings and Samples showing the full range of colors, textures, and patterns available for each type of finish.
- B. Quality Standard: Architectural Woodwork Institute's "Architectural Woodwork Quality Standards."
- C. Forest Certification: Interior woodwork to meet NAUF requirements. FSC certification is not required.
- D. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is completed, and HVAC system is operating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hardboard: AHA A135.4.
- B. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
- C. Softwood Plywood: DOC PS 1.
- D. Hardwood Plywood and Face Veneers: HPVA HP-1, made with adhesive containing no urea formaldehyde.
- E. Thermoset Decorative Panels: Comply with LMA SAT - 1.
- F. High-Pressure Decorative Laminate: NEMA LD 3.
 - 1. Products:
 - a. Wilsonart, High Pressure Laminate, www.wilsonart.com.
 - b. Formica, High Pressure Laminate, www.formica.com.
 - c. Arborite, High Pressure Laminate, www.arborite.com.
 - d. Laminart, High Pressure Lmainate, www.laminart.com.
 - e. Or approved equal.
- G. Solid-Surfacing Material: Quartz (See Section 123661.19 Quartz Agglomerate Countertops)
 - 1. Products:
 - a. Wilsonart LLC, Quartz, www.wilsonart.com.

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- b. Cambria, Quartz, www.cambriausa.com
- c. Caesarstone, Quartz, www.caesarstone.com
- d. Corian, Quartz, www.corianquartz.com
- e. LX Hausts, Viatera & Hi Macs, www.LXhausts.com
- f. Or approved equal.

2.2 CABINET HARDWARE AND ACCESSORY MATERIALS

- A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening.
- B. Wire Pulls: Back mounted, solid metal, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter.
- C. Catches: Magnetic catches, BHMA A156.9, B03141.
- D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.
- E. Drawer Slides: BHMA A156.9, B05091.
 - 1. Box Drawer Slides: Grade 1HD-100.
 - 2. File Drawer Slides: Grade 1HD-200.
 - 3. Pencil Drawer Slides: Grade 1.
 - 4. Keyboard Slides: Grade 1HD-100.
 - 5. Trash Bin Slides: Grade 1HD-200.
- F. Drawer Locks: BHMA A156.11, E07041.
- G. Grommets for Cable Passage through Countertops: 2 inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
- H. Exposed Hardware Finishes: Comply with BHMA A156.18 for BHMA code number indicated.
 - 1. Finish: Satin Stainless Steel: BHMA 630.
 - 2. Dull Chrome 26d finish is also acceptable
- I. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated lumber, kiln dried to 15 percent moisture content.

2.3 INTERIOR WOODWORK

- A. Complete fabrication to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- C.

INTERIOR ARCHITECTURAL WOODWORK

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Wood Cabinets for Transparent Finish: Premium grade.

1. Type of Cabinet Construction: Face Frame.
2. Door and Drawer Front Style: Raised-panel overlay.
3. Wood Species and Cut for Exposed Surfaces: As indicated on Drawings
 - a. Premium grade, Reclaimed cypress, plain sawn or sliced
4. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
5. Matching of Veneer Leaves: Random match.
6. Veneer Matching within Panel Face: Balance match.
7. Semiexposed Surfaces Other Than Drawer Bodies: Compatible species to that indicated for exposed surfaces, stained to match.
8. Drawer Sides and Backs: Hardwood plywood.
9. Drawer Bottoms: Hardwood plywood.

Wood Shelving for Opaque Finish: Custom grade.

10. Type of Shelving Construction: Face Frame.
11. Wood:
 - a. Paint grade, Hardwood plywood, or
 - b. Paint grade, solid-hardwood lumber
12. Semiexposed Surfaces Other Than Drawer Bodies: Same as indicated for exposed surfaces, painted to match.

D. Columns and Beams: Premium grade Reclaimed Pine, as indicated on Drawings, to receive transparent high-solid, UV resistant, satin stain.

E. Plastic-Laminate Cabinets: Standard grade (PL-2), Premium Grade (PL-1)

1. AWI Type of Cabinet Construction: Flush overlay on face frame
2. WIC Construction Style: Style B, Face Frame.
3. WIC Door and Drawer Front Style: Flush.
4. Laminate Cladding: Horizontal surfaces other than tops, HGS; postformed surfaces, HGP; vertical surfaces, HGS; Edges, HGS; semiexposed surfaces, VGS or Melamine
5. Drawer Sides and Backs: Standard grade, made from domestic rotary cut white birch. MDF substrate is acceptable
6. Drawer Bottoms: Standard grade, made from domestic rotary cut white birch. MDF substrate is acceptable

F. Plastic-Laminate Countertops: Standard grade.

1. Laminate Grade: HGS for flat countertops, HGP for post-formed countertops.
2. Grain Direction: Grain direction is not a constant.
3. Edge Treatment: Same as laminate cladding on horizontal surfaces.

G. Solid-Surfacing Material Countertops: Standard grade.

1. Solid-Surfacing Material Thickness: Refer to drawings.
2. Fabricate tops in one piece with shop-applied backsplashes and edges where shown in drawings.

2.4 SHOP FINISHING OF INTERIOR ARCHITECTURAL WOODWORK

A. Finishes: Same grades as items to be finished.

B. Finish architectural woodwork at the fabrication shop; defer only final touch up until after installation.

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1. Apply one coat of sealer or primer to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces.
 2. Apply a vinyl wash coat to woodwork made from closed-grain wood before staining and finishing.
 3. After staining, if any, apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
- C. Transparent Finish: AWI finish system synthetic penetrating oil.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Install woodwork to comply with referenced quality standard for grade specified.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Fasten with countersunk concealed fasteners and blind nailing. Use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
- G. Anchor paneling to supports with concealed panel-hanger clips and by blind nailing on back-up strips, splined-connection strips, and similar associated trim and framing.
- H. Cabinets: Install so doors and drawers are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
 1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- I. Anchor countertops securely to base units. Seal space between backsplash and wall.

END OF SECTION 06 40 23

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass-fiber blanket insulation.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corporation.
 - 2. Guardian Building Products, Inc.
 - 3. Johns Manville.
 - 4. Knauf Insulation.
 - 5. Owens Corning.
- B. Glass-Fiber Blanket, Reinforced-Foil Faced wall insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
 - 1. Thickness/R-Value unless indicated differently in drawings:
 - a. Exterior walls: 6"/R-20.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

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- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 - 5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION 072100

SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

A. SUMMARY

1. SECTION INCLUDES

- A. Basis of Design: Open-cell, spray-applied, polyurethane foam insulation. (Carlisle -SealTite Pro Open Cell)

B. RELATED SECTIONS

- A. Section 07 21 19 - Foamed-In-Place Insulation.
- B. Section 07 27 19 - Plastic Sheet Air Barriers .
- C. Section 07 27 00 - Air Barriers.
- D. Section 09 96 13 - Abrasion-Resistant Coatings.

C. REFERENCES

ASTM International (ASTM):

ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.

ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.

ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.

ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.

ASTM D2856 - Standard Test Method for Open-Cell Content of Rigid Cellular Plastics by the Air Pycnometer.

ASTM D6226 - Standard Test Method for Open Cell Content of Rigid Cellular Plastics.

ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

ASTM E413 - Classification for Rating Sound Insulation.

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ASTM E423 - Standard Test Method for Normal Spectral Emittance at Elevated Temperatures of Nonconducting Specimens.

ASTM E2178 - Standard Test Method for Air Permeance of Building Materials.

ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

ICC Evaluation Service (ICC-ES):

ICC-ES AC377 - Acceptance Criteria for Spray-Applied Foam Plastic Insulation.

International Association of Plumbing and Mechanical Officials (IAPMO).

Spray Polyurethane Foam Alliance: Professional Certification Program (SPFA PCP).

D. SUBMITTALS

1. Submit under provisions of Section 01 30 00 - Administrative Requirements.
2. Product Data: Submit manufacturer's product data, including surface preparation and application instructions.
3. Manufacturer's Certification:
 - A. Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
 - B. Submit manufacturer's certification from SPFA PCP as Accredited Supplier Company.
 - C. Submit evidence that manufacturer has Dunn & Bradstreet rating of 5A or can supply performance bond.
4. Applicator's Project References: Submit applicator's list of successfully completed polyurethane foam insulation projects, including project name and location, name of architect, and type and quantity of materials applied.
5. Warranty Documentation: Submit manufacturer's standard warranty.

E. QUALITY ASSURANCE

1. Manufacturer's Qualifications:
 - A. Manufacturer regularly engaged, for a minimum of 10 years, in the manufacturing of polyurethane foam insulation of similar type to that specified.
 - B. Accreditation: SPFA PCP as Accredited Supplier Company.
2. Applicator's Qualifications:

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- A. Applicator regularly engaged, for a minimum of 5 years, in application of polyurethane foam insulation of similar type to that specified.
- B. Certified by manufacturer to install their products.
- C. Use persons trained by manufacturer in polyurethane foam insulation application or certified by SPFA PCP as Master Installer - Insulation, Closed Cell.

3. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

4. Mock-Up: Construct a mock-up with actual materials in sufficient time for Architect's review and to not delay construction progress. Locate mock-up as acceptable to Architect and provide temporary foundations and support.

- A. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
- B. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
- C. Retain mock-up during construction as a standard for comparison with completed work.
- D. Do not alter or remove mock-up until work is completed or removal is authorized.

F. PRE-INSTALLATION CONFERENCE

1. Convene a conference approximately two weeks before scheduled commencement of the Work.

2. Require attendance of parties directly affecting Work of this Section, including Contractor, Architect, applicator, and manufacturer's representative.

3. Review the Following: Materials. Protection of in-place conditions. Surface preparation.

- A. Application.
- B. Field quality control.
- C. Cleaning.
- D. Protection.
- E. Coordination with other Work.

G. DELIVERY, STORAGE, AND HANDLING

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1. Delivery Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

2. Storage and Handling Requirements:

- A. Store and handle materials in accordance with manufacturer's instructions.
- B. Keep materials in manufacturer's original, unopened containers and packaging until application.
- C. Store materials in clean, dry area indoors.
- D. Store materials at 70 to 80 degrees F (21 to 27 degrees C) a minimum of 48 hours before use.
- E. Store materials out of direct sunlight.
- F. Protect materials from freezing.
- G. Protect materials during storage, handling, and application to prevent contamination or damage.
- H. Store and handle materials in accordance with manufacturer's instructions.
- I. Keep materials in manufacturer's original, unopened containers and packaging until application.
- J. Store materials in clean, dry area indoors.
- K. Store materials at 70 to 80 degrees F (21 to 27 degrees C) a minimum of 48 hours before use.
- L. Store materials out of direct sunlight.
- M. Protect materials from freezing.
- N. Protect materials during storage, handling, and application to prevent contamination or damage.

H. PROJECT CONDITIONS

1. Ambient and Substrate Temperatures: As recommended by Manufacturer.

2. Moisture: Do not apply polyurethane foam insulation when moisture in form of rain, snow, ice, fog, frost, or dew is expected during application.

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3. Relative Humidity: Do not apply polyurethane foam insulation when relative humidity over 85 percent is expected during application.
4. Wind: Do not apply polyurethane foam insulation with wind speed above 12 mph (19 kmh).
5. Do not apply polyurethane foam insulation under ambient conditions outside manufacturer's limits.

I. WARRANTY

1. Manufacturer's Warranty: Provide manufacturer's standard limited warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Acceptable Manufacturer: Carlisle Spray Foam Insulation, which is located at: 100 Enterprise Dr.; Cartersville, GA 30120; Tel: 844-922-2355; Email: [request info \(\)](#); Web: <https://www.carlislesfi.com>

2. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 OPEN-CELL, SPRAY-APPLIED, POLYURETHANE FOAM INSULATION

1. Basis of Design: SealTite Pro Open Cell; as manufactured by Carlisle Spray Foam Insulation.

A. Performance and Design Requirements:

1. Standards Compliance:

- A. Acceptance Criteria: ICC-ES AC377, Appendix X, for use with approved intumescent coating.
- B. Evaluation Report: IAPMO UES-624.
- C. Greenguard Certified.

2. Air Leakage Rate, ASTM E2178: Less than 0.004 cfm per sq ft (0.02 L per sec per sq m).

3. Moisture Vapor Transmission, Permeance at 1 inch (25 mm), ASTM E96: 21 perm.

4. Core Density, ASTM D1622: 0.5 pcf (8 kg per cu m), nominal.

5. R-Value, Aged, ASTM C518:

- A. Thickness, 1 inch (25 mm): 3.7.
- B. Thickness, 3.5 inches (89 mm): 13.
- C. Thickness, 5.25" (152.4 mm) : 19.

6. Tensile Strength, ASTM D1623: Less than 3.0 psi (21 kPa), nominal.

7. Dimensional Stability, ASTM D2126, Change in Volume: Less than 15 percent.

8. Open Cell Content, ASTM D2856: Greater than 90 percent.

9. Ozone Depletion Potential: Zero.

10. Surface Burning Characteristics, ASTM E84, 4 Inches (102 mm):

- A. Flame Spread Index: Less than 25.
- B. Smoke Developed Index: Less than 450.

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- B. Description: Two-component, light-density, one to one by volume system.

- C. Primer: As required by manufacturer for application of spray foam.

- D. Intumescent Coating: DC315 as manufactured by International Fireproof Technology, Inc.

- E. Intumescent Coating: Fireshell BMS TC as manufactured by TPR Corporation.

- F. Intumescent Coating: No-Burn Plus ThB as manufactured by No-Burn, Inc.

- G. Intumescent Coating: Specified in 09960.

PART 3 - EXECUTION

3.1 EXAMINATION

1. Examine areas to receive polyurethane foam insulation.
2. Notify Architect of conditions that would adversely affect application.
3. Do not begin surface preparation or application until unacceptable conditions are corrected.

3.2 PREPARATION

1. Protection of In-Place Conditions:
 2. Protect adjacent surfaces from contact with overspray.
 3. Protect electrical outlet and junction boxes from contact with polyurethane foam insulation.
4. Surface Preparation:

- A. Prepare surfaces in accordance with manufacturer's instructions.

- B. Remove dirt, dust, debris, oil, grease, rust, loose scale, ice, frost, moisture, and other surface contaminants which could adversely affect application of polyurethane foam insulation.

3.3 INSTALLATION

1. Spray-apply polyurethane foam insulation in accordance with manufacturer's instructions at locations indicated on the Drawings.
2. Material Temperature: Maintain materials in containers at 65 to 85 degrees F (18 to 29 degrees C) while in use.

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3. Ensure substrates are dry during application.

4. Insulation Thickness:

A. Maximum Pass Thickness: 4 inches (102 mm).

B. Total Thickness: Indicated on the Drawings.

5. Intumescent Coating:

A. Cover polyurethane foam insulation with intumescent coating at locations indicated on the Drawings.

B. Apply intumescent coating as specified in Section 09 96 13 - Abrasion-Resistant Coatings.

3.4 FIELD QUALITY CONTROL

1. Field Inspection: Coordinate field inspection in accordance with manufacturer's recommendations in order to obtain full product warranty.

2. Inspect completed application of polyurethane foam insulation, including:

A. Total thickness.

B. Free of voids, pinholes, cracks, and crevices.

C. Adhesion to substrate.

3.5 CLEANING AND PROTECTION

1. Promptly clean surfaces that receive overspray of polyurethane foam insulation.

2. Do not use harsh cleaning materials or methods that could damage surfaces.

3. Protect Work of this Section from damage during construction.

END OF SECTION

SECTION 072129 – SPRAYED CELLULOSE ACOUSTICAL INSULATION

PART 1 – GENERAL

1.01 Section Includes

- A. Sprayed cellulose thermal insulation.
- B. Sprayed cellulose acoustical insulation.

1.02 Related Items

- A. Clips, hangers, supports, sleeves and other attachments to spray bases are to be placed by other trades prior to the application of sprayed insulation.
- B. Ducts, piping, conduit or other suspended equipment shall not be positioned until after the application of sprayed insulation.
- C. Roof penetrations to be installed prior to application.

1.03 Quality Assurance

- A. Manufacturer must have a current Underwriters Laboratories (UL) Code Evaluation Report.
- B. Manufacturer must be in compliance with the 2009 and 2012 International Building Code.
- C. Manufacturer must be ISO 9001:2015 Certified.
- D. Applicator: Licensed by manufacturer.
- E. Manufacturer must subscribe to independent laboratory follow-up inspection services of Underwriters Laboratories and Factory Mutual. Each bag shall be labeled accordingly.
- F. Mock-up: Apply a 100 square foot representative sample to be reviewed by the Architect and/or Owner prior to proceeding.

1.04 Submittals

- A. Submit product data that the product meets or exceeds the following specified requirements.
 - 1. Bond strength shall be greater than 100 psf per ASTM E 736.
 - 2. Product shall be Class 1 Class A per ASTM E 84/ UL 723.
 - 3. Non-corrosive per ASTM C 739.
 - 4. Bond Deflection per ASTM E 759: 6" Deflection in 10' Span – No Spalling or Delamination.
 - 5. R-Value to be 3.75 per inch per ASTM C 518.
 - 6. Comply with 2009 IBC Section 803.10 stability requirements for interior finishes.
 - 7. Meet ASTM C 1149
- B. Manufacturer's written certification that product contains no asbestos, fiberglass or other man-made mineral fibers.
- C. Copy of manufacturer's ISO 9001:2015 Certification.
- D. Minimum Fiber Recycled Content to be 75%.
- E. Cannot contain any added Urea-Formaldehyde Resins.

1.06 Delivery, Storage and Handling

- A. Deliver in original, unopened containers bearing name of manufacturer, product identification and reference to U.L. testing.
- B. Store materials dry, off ground, and under cover.
- C. Protect liquid adhesive from freezing.
- D. Water to be potable.

PART 2 – PRODUCTS

2.01 Acceptable Manufacturers

- A. International Cellulose Corporation
12315 Robin Boulevard
Houston, Texas 77045
(713) 433-6701 or (800) 444-1252
FAX: (713) 433-2029
www.spray-on.com icc@spray-on.com
- B. Or Approved Equal

2.02 Materials

- A. K-13 Spray-On-Systems.
 - 1. Color shall be from Manufacturer's standard color chart.
 - 2. Comply with local Building Code requirements.
 - 3. Material to have been tested in accordance with ASTM E 1042. Testing laboratory must be NVLAP accredited.

PART 3 – EXECUTION

3.01 Examination

- A. Examine surfaces and report unsatisfactory conditions in writing. Do not proceed until unsatisfactory conditions are corrected.
- B. Verify surfaces to receive spray insulation to determine if priming/sealing is required to insure bonding and/or to prevent discoloration caused by migratory stains.

3.02 Preparation

- A. Provide masking, drop cloths or other satisfactory coverings for materials/surfaces that are not to receive insulation to protect from over-spray.
- B. Coordinate installation of the sprayed cellulose fiber with work of other trades.
- C. Prime surfaces as required by manufacturer's instructions or as determined by examination.

3.03 Installation

- A. Install spray applied insulation according to manufacturer's recommendations.
- B. Install spray applied insulation to achieve an average R-Value of ____.
- C. Install spray applied insulation to achieve an average NRC of 1.05.

| K-13 Sprayed Thermal and Acoustical Insulation on 1.50" Metal Deck: | | |
|---|------|----------|
| Thickness: | NRC: | R-Value: |
| 1.50" | 1.05 | 5.60 |
| 3.00" | 1.05 | 11.10 |

| K-13 Sprayed Thermal and Acoustical Insulation on 2" Metal Deck: | | |
|--|------|----------|
| Thickness: | NRC: | R-Value: |
| 1.00" | 0.90 | 3.70 |
| 2.00" | 1.05 | 7.40 |

- D. Cure insulation with continuous natural or mechanical ventilation.
- E. Remove and dispose of over-spray.

3.04 Protection

- A. Protect finished installation under provision of Division 1.

END OF SECTION

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vapor-permeable, fluid-applied air barriers on exterior wall sheathing.

1.2 PREINSTALLATION MEETING

- A. Preinstallation Conference: Conduct conference at project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For air-barrier assemblies.

1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1.4 INFORMATION SUBMITTALS

- A. Field Quality-Control Reports

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and experienced in installing fluid-applied membrane air barriers.

- B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly full height of exterior wall by 8'-0" wide incorporating backup wall construction, window, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air-barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection and testing of air-barrier before external cladding is installed.
 - b. Arrange for manufacturer's representative to inspect, write a report and approve the mockup prior to installing all the fluid-applied membrane on exterior walls.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq.ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa) when tested according to ASTM E 2357.

2.2 HIGH-BUILD AIR BARRIERS, VAPOR PERMEABLE

- A. High-Build, Vapor-Permeable Air Barrier: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils (0.9 mm) or thicker over smooth, void-free substrates.
 - 1. Synthetic Polymer Type:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Prosoco R-Guard
 - 2) Grace Vycor EnV
 - 2. Physical and Performance Properties
 - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq.ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
 - b. Vapor Permeance: Minimum 10 perms (580 ng/Pa x s x sq. m); ASTM E 96/E 96M, Desiccant Method, Procedure A.
 - c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
 - d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested according to ASTM D 4541.
 - e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 - f. UV Resistance: Can be exposed to sunlight for days according to manufacturer's written instructions.
 - g. Rain Screen: Provide products suitable for installation in rain screen applicants.
 - h. Wind Requirements: Provide products suitable for applicable Hurricane Wind Zone.

2.3 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

- C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- F. Bridge expansion joints and discontinuous wall-to-wall, joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.2 INSTALLATION

- A. Install materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
 - 1. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air barrier material on same day. Re-prime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to exterior glazing and window systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. Wall Openings: Prime concealed, perimeter frame surfaces of windows and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.
- D. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fish-mouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.
- E. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.
 - 1. Vapor-Permeable, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils (0.9 mm), applied in one or more equal coats.
- F. Do not cover air-barrier until it has been inspected and approved by the manufacturer's representative.
- G. Correct deficiencies in or remove air-barrier that does not comply with requirements and the manufacturer's representative's report; repair substrates and reapply air-barrier components.

3.3 FIELD QUALITY CONTROL

- A. Contractor: Engage a manufacturer's representative inspections and issue reports to the contractor and Architect.
- B. Inspections: As determined by manufacturer's representative from among the following:
 - 1. Air-barrier dry film thickness.
 - 2. Air-Leakage-Location inspections.
 - 3. Adhesion inspection.
- C. Air-barriers will be considered defective if they do not pass inspections.

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1. Apply additional air-barrier materials, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for reinspections as specified above.

D. Prepare inspection reports.

3.4 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
- B. Remove masking materials after installation.

END OF SECTION 072726

SECTION 074213.23 - METAL COMPOSITE MATERIAL WALL PANELS

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 metal composite material wall panels.

1.3 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, metal composite material panel system manufacturer's representative, 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.

1.4 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.

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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. Custom color sample are not available for this requirement. Standard color samples will be substituted.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
 - B. Product Test Reports or 3rd Party Certifications: For each product, tests performed by a qualified testing agency.
 - C. Field quality-control reports.
 - D. Sample Warranties: For special warranties.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For metal composite material panels to include in maintenance manuals.
- 1.7 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 shown on Drawings] <Insert size>, 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.
- 1.8 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.

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- 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. Natural Metal Composite Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.9 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: Wall Panel System 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: 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: 20 years plus 1 year from date of shipment from MCM panel manufacturer.
- C. Panel Integrity Warranty: 10 years plus 1 year from date of shipment from MCM panel manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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- 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 1/180 of the perimeter span and L/60 center of panel.
- 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: 6.24 lbf/sq. ft. (300Pa).
- C. Water Penetration under Static Pressure: No uncontrolled water penetration when tested for 15 minutes 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): minus 20 degrees F to 180 degree F , material surfaces.
- E. Fire-Resistance Ratings (When Required): 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.
- F. Fire Propagation Characteristics (When Required): Metal composite material wall panel system passes NFPA 285 testing.

2.2 METAL COMPOSITE MATERIAL WALL PANELS

- A. MCM Wall Panel Systems: Provide factory-formed and -assembled, MCM 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: Subject to compliance with requirements, provide ALUCOBOND®; 3A Composites USA Inc.; ALUCOBOND® PLUS or comparable product
- B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch- (0.50-mm-) thick, coil-coated aluminum sheet facings.
 - 1. Panel Thickness: 0.157 inch (4 mm).
 - 2. Core: PE.
 - 3. Exterior Finish: Two-coat fluoropolymer.
 - a. Color: As selected by Architect from manufacturer's full range.
- C. Attachment Assembly Components: Formed from extruded aluminum.
- D. Attachment Assembly: Rainscreen principle system.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Sub-framing 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, fasciae, 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, end-walls, 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.

2.4 FABRICATION

- A. General: Fabricate and finish metal composite material panels and accessories at the factory, by panel wall system 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 wall panel joints that provide a weathertight seal 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.

2.5 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: To comply with AAMA 2605 or AAMA 611 as appropriate.

PART 3 - EXECUTION

3.1 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.

3.2 PREPARATION

- A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

3.3 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.
 2. Copper Panels: Use stainless-steel fasteners.
- 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 sub-girts, 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. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
 2. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gasket system.
 3. 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. 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.
- H. 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).

3.4 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.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: 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 as specified in AAMA 2605.
- 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.

3.6 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 074213.23

SECTION 074213.53 - METAL SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes metal soffit panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site with Architect and Project Manager present.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two 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 panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: Associated with 121 MPH winds.
 - 2. Other Design Loads: As required to comply with ASTM E 1592.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 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: 6.24 lbf/sq. ft. (300 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METAL SOFFIT PANELS

- A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners inside laps. Include accessories required for weathertight installation.
- B. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and between panel edges; with flush joint between panels.
 - 1. Basis of Design Product – MBCI Artisan Series, 10" wide panels or other approved manufacturers.
 - 2. Aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.028 inch (0.71 mm) (24 gauge).
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 - 3. Panel Coverage: 10 inches.
 - 4. Panel Height: 1.0 inch (25 mm).

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Sub-framing 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 panel system.

- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or pre-molded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Where necessary, provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are non-staining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/8 inch (3 mm) thick.
 - 2. Joint Sealant: ASTM C 920; as recommended in writing by metal panel manufacturer.

2.4 FABRICATION

- A. General: Fabricate and finish metal 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. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal 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.
- D. 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.

2.5 FINISHES

- A. Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.
 - 1. Soffit Framing: Mechanically attach furring channels to supports, as required to comply with requirements for assemblies indicated.

3.2 METAL PANEL INSTALLATION

- A. Metal Soffit Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 - 1. Apply panels and associated items true to line for neat and weathertight enclosure.
 - 2. Where needed, provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 - 3. Where needed, locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 - 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- B. Watertight Installation:
 - 1. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - 2. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.
- C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
- D. 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.

3.3 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213.53

SECTION 074243 - COMPOSITE WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior panelized fiber-cement rainscreen cladding system and accessories.

1.2 DEFINITIONS

- A. DBVR: Drained and back ventilated rainscreen system; designed to drain and dry cavity entering water through drainage channels, weeps, and air ventilation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, composite panel Fabricator and Installer, composite panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects composite 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 composite 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 composite panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for composite 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.

1.4 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 as indicated on the Construction Drawings.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Laboratory Test Reports: For ceilings and walls, indicating compliance with requirements for low-emitting materials.

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C. Shop Drawings:

1. Include details of panel dimensions, profiles, edge conditions, joints, 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).

D. Samples for Initial Selection: For each type of composite panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Composite Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other composite panel accessories. Submit custom color samples in paint manufacturer's standard size.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

1. Composite Manufacturer's Material Test Reports: Certified test reports showing compliance with specific performance or third-party listing documenting compliance to comparable code sections IBC 1404.16.1 and IBC 1703.5. (IBC 2021)
2. Composite Panel System Fabricator's Certified System Tests Reports: Certified system test reports showing system compliance with specific performance or third-party listing documenting compliance code section. Base performance requirements on composite panel system type provided.
 - a. DBVR System: Tested to AAMA 509.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For composite panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by composite panel fabricator.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for composite panel fabrication and installation.

1. Build mockup of typical composite panel assembly 8' X 8', including corner, soffits, supports, attachments, and accessories.
2. Water-Spray Test: Conduct water-spray test of mockup of composite panel assembly, testing for water penetration in accordance with 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.

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4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, composite panels, and other manufactured items so as not to be damaged or deformed. Package composite panels for protection during transportation and handling.
- B. Unload, store, handle, and erect composite panels in a manner to prevent bending, cracking, warping, twisting, and surface damage.
- C. Stack composite panels on platforms or pallets no more than two pallets high, covered with suitable weathertight and ventilated covering.
- D. Store composite panels to ensure dryness, with positive slope for drainage of water. Do not store composite panels in contact with other materials that might cause staining, denting, or other surface damage. Ensure panels are fully dry before installation.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of composite panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate composite 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. Warranty on Panel Material: Manufacturer agrees to replace fiber cement that fails within specified warranty period.
 1. Warranty Period: [15] [20] years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer agrees to repair finish or replace composite panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Finish Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Physical Performance: Provide composite panel system in accordance with ASTM C1186.
 1. Wet Flexural Strength: Result: 1418 psi (9777 kPa), Lower Limit: 1015 psi (6998 kPa).
 2. Water Tightness: No water droplets observed on any specimen.
 3. Freeze-Thaw: No damage or defects observed.

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4. Warm Water: No evidence of cracking, delamination, swelling, or other defects observed.
 5. Heat-Rain: No crazing, cracking, or other deleterious effects, or surface or joint changes observed in any specimen.
- B. Structural Performance: Provide composite panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E330/E330M:
1. Design Wind Loads: Reference Structural Drawings.
 2. Other Design Loads: Reference Structural Drawings.
 3. Deflection Limits: For wind loads, panel deflection no greater than L/120 of the span.
- C. Thermal Expansion: Maximum 0.00000318 deg F to minus 1 (0.000005724 deg C to minus 1) when tested in accordance with ASTM E228.
- D. Air Leakage: 1.53 cfm/sq. ft. (7.78 L/s/sq. m) or less in accordance with AAMA5094.
- E. Water Penetration under Static Pressure: No water penetration to room side of assembly when tested for 15 minutes in accordance with ASTM E331 at the following test-pressure difference:
1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).
- F. Fire Propagation Characteristics: Composite panel wall assembly passes NFPA 285.
- G. Surface-Burning Characteristics: Provide composite panels that meet the following values when tested in accordance with ASTM E84:
1. Flame-Spread Index: Zero.
 2. Smoke-Developed Index: 5.
- H. Fire Resistance: Composite panel wall assembly passes ASTM E119.
- I. Ignition Resistance: Composite panel passes NFPA 268.

2.2 COMPOSITE WALL PANELS

- A. Composite Wall Panel Systems: Provide factory-formed and -assembled, composite wall panels fabricated from a pressed, stamped, and autoclaved mix of portland cement, fly ash, silica, recycled rejects, and wood fiber bundles; formed into profile for installation method indicated. Include attachment assembly components and accessories required for weathertight system.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Nichiha Architectural Wall Panels
- B. Wall Panels:
1. Panel Dimensions: 17-7/8 by 71-9/16 inches (455 by 1818 mm).
 2. Panel Thickness: 5/8 inch (16 mm).
 3. Panel: Factory sealed on all six sides.
 4. Profiles: Wood plank texture with 3/8-inch (10-mm) grooves, running lengthwise at 6 inches (152 mm) o.c.
 5. Color: As selected by Architect from manufacturer's full range.
 6. Accessory Components: Manufactured corners with 3-1/2-inch (89-mm) returns.
- C. Smooth, High-Gloss Composite Wall Panels:
1. Panel Dimensions: 17-7/8 by 71-9/16 inches (455 by 1818 mm).

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2. Panel Thickness: [5/8 inch (16 mm).
 3. Panel: Factory sealed on all six sides.
 4. Profiles: None.
5. Color: As selected by Architect from manufacturer's full range.
6. Accessory Components: None.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet with ASTM A653/A653M, G90 (Z275) hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide Fabricator's standard sections as required for support and alignment of composite panel system.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Nichiha Architectural Wall Panels; Ultimate Horizontal and Vertical Starter Track
- B. required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of composite panels unless otherwise indicated.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Nichiha Architectural Wall Panels; Ultimate Clip System
- C. Flashing and Trim: Provide anodized aluminum flashing and trim 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.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Nichiha Architectural Wall Panels; Essential Flashing System
 2. Aluminum Trim: Formed with 0.040-inch (1.00-mm-) thick, coil-coated aluminum sheet facings.
 3. Color: As selected by Architect from manufacturer's full range.
- D. Panel Fasteners: Provide corrosion-resistant fasteners as required for construction method used.
- E. Panel Sealants: ASTM C920, Class 35; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in composite panels and remain weathertight; and as recommended in writing by composite panel manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, composite 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 composite 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 composite 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 composite panels to verify actual locations of penetrations relative to seam locations of composite panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with composite panel manufacturer's written instructions.

3.3 COMPOSITE PANEL INSTALLATION

A. General: Install composite panels in accordance with Fabricator's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor composite panels and other components of the Work securely in place, with provisions for thermal and structural movement.

- 1. Shim or otherwise plumb substrates receiving composite panels.
- 2. Flash or seal composite panels at perimeter of all openings. Fasten flashing with manufacturer-approved fasteners. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by composite 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 composite panel work proceeds.
- 6. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

- 1. Composite Panels: Use hot-dip galvanized, ceramic-coated, or stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Attachment Assembly, General: Install attachment assembly required to support composite wall panels and to provide a complete weathertight wall system, including sub-girts, 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.

D. Panel Installation: Attach composite wall panels to supports at locations, at spacings, and with fasteners recommended in writing by Fabricator to achieve performance requirements specified.

- 1. DBVR Rainscreen System: Install using Fabricator's standard assembly with horizontal channel that provides support and secondary drainage assembly, draining at base of wall. Attach composite wall panels by placing panel clips to supports at locations, at spacings, and with fasteners recommended in writing by Fabricator.
 - a. Track-Support Installation: Install support assembly at locations, at spacings, and with fasteners recommended in writing by manufacturer. Use Fabricator's standard horizontal tracks that provide support and secondary drainage assembly.
 - b. Panel Installation:
 - 1) Attach composite wall panels by interlocking panel edges with Fabricator's standard clips.
 - c. Joint Sealing: Seal all joints in accordance with AAMA 509. Do not apply sealants to joints unless otherwise indicated.

- E. 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 composite panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by composite panel Fabricator; or, if not indicated, provide types recommended in writing by composite system Fabricator.
- F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, or 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 ft. (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).

3.4 ERECTION TOLERANCES

- A. Site Verifications of Conditions:
 - 1. Verify that conditions of substrate previously installed under other Sections are acceptable for composite system installation. Provide documentation indicating detrimental conditions to composite system performance.
 - 2. Once conditions are verified, composite system installation tolerances are as follows:
 - a. Shim and align composite wall panel units within installed tolerance of 1/4 inch in 20 ft. (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.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration in accordance with AAMA 501.2.
- C. Fabricator's Field Service: Engage a factory-authorized service representative to test and inspect completed composite wall panel installation, including accessories.
- D. Composite 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.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings, if any, as composite panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of composite panel installation, clean finished surfaces as recommended by composite panel manufacturer. Maintain in a clean condition during construction.
- B. After composite panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace composite panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074243

SECTION 075423 – THERMOPLASTIC-POLYOLEFIN SINGLE-PLY ROOFING MEMBRANE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Thermoplastic Polyolefin Single-Ply Roofing Membrane
2. Thermoplastic Polyolefin Flashings
3. Thermoplastic Polyolefin Accessories
4. Insulation

B. Related Sections

1. Section 06100: Rough Carpentry
2. Section 07620: Sheet Metal Flashing and Trim
3. Section 15430: Plumbing Specialties

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM) - *Annual Book of ASTM Standards*

1. ASTM D-751 – Standard Test Methods for Coated Fabrics
2. ASTM D-2137 - Standard Test Methods for Rubber Property—Brittleness Point of Flexible Polymers and Coated Fabrics
3. ASTM E-96 - Standard Test Methods for Water Vapor Transmission of Materials
4. ASTM D1204 - Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheet or Film at Elevated Temperature
5. ASTM D-471 - Standard Test Method for Rubber Property—Effect of Liquids
6. ASTM D-1149 - Standard Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment
7. ASTM C-1549 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
8. ASTM C-1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emitters
9. ASTM E 903 – Standard Test Method for Solar Absorptance, Reflectance, and Transmission of Materials Using Integrating Spheres
10. ASTM D573 - Standard Test Method for Rubber - Deterioration in An Air Oven
11. ASTM D7635 – Optical Method – Thickness Over Scrim
12. ASTM D1876 – Field Seam Strength
13. FTM 101C – Puncture Resistance
14. ASTM C1289 – Type II, Class 1
15. UL Standard 790, 263 and 1256 – Component of Class A Roof Systems
16. FM Standards 4450 / 4470 – Class 1 Approval for Steel Roof-Deck Construction

B. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - *Architectural Sheet Metal Manual*

C. National Roofing Contractors Association (NRCA)

D. American Society of Civil Engineers (ASCE)

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- E. U.S. Green Building Council (USGBC)
- F. Factory Mutual (FM Global) - *Approval Guide*
- G. Underwriters Laboratories (UL) - *Roofing Systems and Materials Guide* (TGFU R1306)
- H. ENERGY STAR
- I. Cool Roofing Rating Council (CRRC)

1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D1079 and the glossary of the National Roofing Contractors Association (NRCA) *Roofing and Waterproofing Manual* for definitions of roofing terms related to this section.

1.4 SUBMITTALS

- A. Product Data: Provide product data sheets for each type of product included within entire roof assembly and construction.
- B. Shop Drawings: Provide manufacturers standard details and approved shop drawings for the roof system specified. Shop drawings must be submitted to Carlisle by the Carlisle Authorized Roofing Applicator along with a completely executed Notice of Award for approval. Approved shop drawings are required for inspection of the roof and on projects where on-site technical assistance is requested. Submit Carlisle approved shop drawings to Architect for review.

Shop drawings must include:

1. Outline of roof and size
2. Deck type
3. Location and type of all penetrations
4. Perimeter and penetration details
5. Key plan (for multiple roof areas) with roof heights indicated
6. Sheet width and number of perimeter sheets for Mechanically Fastened systems
7. Fastener type, length and maximum spacing (for membrane securement) for Reinforced Mechanically Fastened systems.

When field conditions necessitate modifications to originally approved shop drawings, a copy of the shop drawing outlining all modifications must be submitted for review.

- C. Samples: Provide samples of insulations, fasteners, membrane materials and accessories for verification of quality.
- D. Certificates: Installer shall provide written documentation from the manufacturer of their authorization to install the roof system, and eligibility to obtain the warranty specified in this section.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Carlisle Syntec Systems shall provide a roofing system that meets or exceeds all criteria listed in this section.
- B. Installer's Qualifications:

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1. The specified roofing system must be installed by a Carlisle Authorized Roofing Applicator in compliance with drawings and specifications as approved by Carlisle SynTec.

C. Source Limitations: All components listed in this section shall be provided by a single manufacturer or approved by the primary roofing manufacturer.

D. Final Inspection

Manufacturer's representative shall provide a comprehensive final inspection after completion of the roof system. All application errors must be addressed, and final punch list completed. An inspection shall be conducted by a Field Service Representative of Carlisle to ascertain that the membrane roofing system has been installed according to Carlisle's published specifications and details applicable for the specific project.

1.6 PRE-INSTALLATION CONFERENCE

A. Prior to scheduled commencement of the roofing installation and associated work, conduct a meeting at the project site with the installer, architect, owner, Carlisle representative and any other persons directly involved with the performance of the work. The contractor shall record conference discussions to include decisions and agreements reached (or disagreements) and furnish copies of recorded discussions to each attending party. The main purpose of this meeting is to review foreseeable methods and procedures related to roofing work.

1.7 PERFORMANCE REQUIREMENTS

A. Provide an installed roofing membrane and base flashing system that does not permit the passage of water and will withstand the design pressures calculated in accordance with the most current revision of ASCE 7.

B. Carlisle Syntec Systems shall provide all primary roofing materials that are physically and chemically compatible when installed in accordance with manufacturers current application requirements.

1.8 REGULATORY REQUIREMENTS

A. All work shall be performed in a safe, professional manner, conforming to all federal, state, and local codes.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver all roofing materials to the job site in original, unopened containers labeled with the manufacturer's name, brand name and installation

B. Store all pail goods in their original undamaged containers in a clean, dry location within their specified temperature range.

C. Do not expose materials to moisture in any form before, during, or after delivery to the site. Reject delivery of materials that show evidence of contact with moisture.

D. Store Sure-Weld membrane in original undisturbed plastic wrap

E. Job site storage temperatures in excess of 90 degrees (F) may affect shelf life of curable materials (IE: adhesives and sealants)

F. When liquid adhesives and sealants are exposed to lower temperatures, restore to a minimum of 60 degrees (F) before use

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- G. Materials shall be stored above 60°F (12.6°C) a minimum of 24 hours prior to application.

1.10 PROJECT CONDITIONS

A. Weather

1. Proceed with roofing only when existing and forecasted weather conditions permit.
2. Refer to Carlisle Technical Manual for applicable project specific Job Conditions

1.11 WARRANTY

- A. Provide Manufacturers Warranty with single source coverage and no monetary limitation where the manufacturer agrees to repair or replace components in the roofing system, which cause a leak due to a failure in materials or workmanship. Warranty Duration must include Warranty Wind Speed Coverage for Max wind speed design per local and state codes.

1. Duration: Twenty (20) years from the date of completion.

*Materials and workmanship of listed products within this section when installed in accordance with current Carlisle application and specification requirements. Contact Carlisle Syntec Systems Contractor Services for the full terms and conditions of the guarantee.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. CARLISLE SYNTEC SYSTEMS, Carlisle, PA 17013
- B. Approved Equal

2.2 INSULATION

- A. Rigid polyisocyanurate board, with a glass-reinforced cellulosic felt facer (GRF). Conforms to or exceeds the requirements of ASTM C 1289 Type II, Class 1, Grade 2. InsulBase Polyiso Insulation, with the following characteristics: (Carlisle recommendation: Confirm)

1. Board Thickness: As required to achieve mandated R-Value for specific project as determined by Local and State adopted codes for Commercial Buildings. As required to achieve a fully functional, water tight roof assembly which performs to the standards and intent of the roof design. Manufacturer to select as appropriate.
2. Thermal Resistance (LTTR value) of: Please refer to the Carlisle Insulation – Data Sheet. Required to meet or exceed all Local and State adopted codes for Commercial Buildings.
3. Compressive Strength: 20 psi min. (Confirm with Manufacturer)

- B. Sloped Rigid polyisocyanurate board, with a glass-reinforced cellulosic felt facer (GRF). Conforms to or exceeds the requirements of ASTM C 1289 Type II, Class 1, Grade 2. InsulBase Tapered Polyiso Insulation, with the following characteristics: (Carlisle recommendation: Confirm)

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1. Board Thickness: As required to achieve mandated R-Value for specific project as determined by Local and State adopted codes for Commercial Buildings. As required to achieve a fully functional, water tight roof assembly which performs to the standards and intent of the roof design. Manufacturer to select as appropriate
2. Thermal Resistance (LTTR value) of: Please refer to the Carlisle Insulation – Data Sheet. Required to meet or exceed all Local and State adopted codes for Commercial Buildings.
3. Compressive Strength: 20 psi min. (Confirm with Manufacturer)

2.3 MEMBRANE MATERIALS

- A. A smooth type, polyester scrim reinforced thermoplastic polyolefin (TPO) membrane with a nominal 0.060-inch (60 mil) thickness, for use as a single ply roofing membrane. Meets or exceeds the minimum requirements of ASTM D-6878. UL Listed, FM Approved, Dade County Product Approval, Florida Building Code Approved. White membrane is Energy Star Listed, CRRC Listed and Title 24 Compliant. (Carlisle recommendation: Confirm)
 1. Product: Carlisle Syntec Systems: Sure-Weld TPO Reinforced Membrane: 60 mil: Mechanically Fastened / Fully Adhered Roofing System
 2. Color: White

2.4 FLASHING MATERIALS (Refer to section C – Related Materials)

- A. A smooth type, polyester scrim reinforced thermoplastic polyolefin (TPO) membrane with a nominal 0.060-inch (60 mil) thickness, for use as a single ply roofing membrane. Meets or exceeds the minimum requirements of ASTM D-6878. UL Listed, FM Approved, Dade County Product Approval, Florida Building Code Approved. White membrane is Energy Star Listed, CRRC Listed and Title 24 Compliant. (Carlisle recommendation: Confirm)
 1. Product: Carlisle Syntec Systems: Sure-Weld TPO Non-Reinforced Flashing: 60 mil
 2. Color: White

2.5 CLEANERS, ADHESIVES, PRIMERS AND SEALANTS

- A. High strength solvent based contact adhesive for bonding of TPO membrane to various porous and non-porous substrates: Sure-Weld TPO (Carlisle Syntec Systems recommendation: Confirm)
- B. CAV-GRIP III Low-VOC Aerosol Contact Adhesive/Primer: a low-VOC, methylene chloride-free adhesive that can be used for a variety of applications including: priming unexposed asphalt prior to applying Flexible FAST Adhesive, adhering Sure-Weld TPO membrane, horizontally, for the field of the roof, and for adhering Sure-Weld/Sure-Flex FleeceBACK and Sure-Weld TPO membrane to vertical walls. Coverage rate is approximately 2,000-2,500 sq. ft. per #40 cylinder and 4,000-5,000 sq. ft. per #85 cylinder as a primer, in a single-sided application; 750 sq. ft. per #40 cylinder and 1,500 sq. ft. per #85 cylinder as an adhesive for vertical walls, in a double-sided application; 1,000 sq. ft. per #40 cylinder and 2,000 sq. ft. per #85 cylinder as an adhesive, horizontally, for the field of the roof, in a double-sided application.
- C. Cut-Edge Sealant: A clear colored sealant used to seal cut edges of reinforced Sure-Weld membrane. A coverage rate of approximately 225 - 275 linear feet per squeeze bottle can be achieved when a 1/8" diameter bead is applied
- D. Water Cut-Off Mastic: Used as a mastic to prevent moisture migration at drains, compression terminations and beneath conventional metal edging (at a coverage rate of approximately 10' per tube or 100' per gallon)
- E. Universal Single-Ply Sealant: A 100% solids, solvent free, voc free, one part polyether sealant that provides a weather tight seal to a variety of building materials. It is white in color and is used for general caulking such as above termination bars and metal counter flashings and at scuppers
- F. White One-Part Pourable Sealer: A one-part, moisture curing, elastomeric polyether sealant used to fill Molded Pourable Sealant Pockets. Packaged in 4, 2-liter foil pouches inside a reusable plastic bucket. 1 pouch will fill 122 cubic inches of volume within a sealant pocket
- G. Weathered Membrane Cleaner: Used to prepare membrane for heat welding that has been exposed to the elements or to remove general construction dirt at an approximate coverage rate of 400 square feet per gallon (one surface).

- H. TPO Primer: A solvent-based primer used to prepare the surface of Sure-Weld Membrane prior to application of Pressure-Sensitive Coverstrip and TPO Pressure-Sensitive RUSS
- I. TPO Low-VOC Primer: A solvent-based, low solids primer used to prepare the surface of Sure-Weld Membrane prior to application of Pressure-Sensitive Coverstrip and TPO Pressure-Sensitive RUSS. This Low-VOC product is ideal for use in states where environmental issues are a concern

2.6 INSULATION ADHESIVE

- A. Insulation Adhesive: (Carlisle Syntec Systems recommendation: Confirm)
- B. Flexible FAST Adhesive: A spray (full coverage) or bead-applied, two-component polyurethane, construction grade, low-rise expanding foam adhesive used for attaching approved insulations to compatible roof decks or existing smooth or gravel surfaced BUR, modified bitumen or cap sheets.
- C. Flexible FAST Dual Tank, Dual Cartridge and 5-gallon Jug Adhesive: A two component (Part A and B), extrusion applied, low rise adhesive for bonding insulation to various surfaces. When extruded at 12" on center the coverage rate is 3000 sq.ft. per Dual Tanks, 600 sq.ft. per carton of Dual Cartridges or 170 sq.ft. per gallon for 5-gallon Jug Adhesive.
- D. OlyBond 500 Bag in a Box – A two-component, polyurethane, low-rise expanding adhesive used to bond insulation to various substrates. Packaged in 5-gallon boxes of Part A and Part B formulations that are applied Thermoplastics 7/2020 41 using a mechanical dispenser system. Applied in 1/2" to 3/4" beads or ribbons at the rate of 1 gallon per 150-250 square feet for 12" o.c. bead spacing. Perimeter bead spacing patterns and acceptable insulation and deck types are listed in the applicable Product Data Sheet.
- E. OlyBond 500 BA Spot Shot - A two-component, polyurethane construction grade, low-rising expanding adhesive designed for bonding insulation to various substrates. Applied in 1/2" to 3/4" beads or ribbons using a portable 1:1 applicator (oversized, dual-cartridge caulking gun). Refer to the Product Data Sheet for bead spacing with reference to building height

2.7 ACCESSORIES

- A. Mechanical Fasteners and Plates (Carlisle Syntec Systems recommendation: Confirm)
 - 1. HP-X Fastener & HP-XTRA Fastener: A #15 diameter or #21 diameter fastener applicable to steel, wood and CDX plywood. Used to secure Sure-Seal, Sure-Weld and Sure-Flex membranes
 - 2. Insulfast Fastener: A #12 diameter fastener applicable to wood decks and steel, 22-gauge and heavier, decks. Used only for insulation attachment
 - 3. Piranha Plate / HP-XTRA Piranha Plate: Along with the appropriate fastener, used to secure Sure-Weld and Sure-Flex membranes to steel, concrete and wood decks.
 - 4. Insulation Fastening Plate: Applicable with InsulFast, HP, CD-10 and HD 14-10 fasteners. Used for insulation securement only on steel, wood and concrete decks.
 - 5. Sure-Weld Pressure-Sensitive RUSS (Reinforced Universal Securement Strip): A 6" or 10" wide, nominal 45-mil thick reinforced TPO membrane STRIP with a nominal 35-mil thick cured TPO splice tape adhesive laminated along one or both edges. (3" wide Factory-Applied TAPE laminated along one edge for the 6" wide RUSS and along both edges for the 10" wide RUSS.)
 - a. 6" wide Pressure-Sensitive RUSS is used horizontally or vertically at the base of walls, curbs, etc., in conjunction with Seam Fastening Plates below the Sure-Weld TPO deck membrane for additional membrane securement. Available in rolls 100' long, 2 per carton.
 - b. 10" wide Pressure-Sensitive RUSS is utilized for perimeter membrane securement along the center of field sheets to form perimeter membranes. Available in rolls 100' long, 1 per carton
- B. METAL ACCESSORIES, EDINGS, COPING, AND TERMINATIONS

General:

Products listed below can be used with any of the available Carlisle Roofing Systems. Refer to the applicable Carlisle details and installation instruction manuals for specific installation criteria. (Carlisle recommendation: Confirm)

1. Sure-Weld Coated Metal: A 24 gauge, galvanized steel sheet coated with a layer of 40-mil non-reinforced Sure-Weld Flashing. The sheet is cut to the appropriate width and used to fabricate metal drip edges or other roof perimeter edging profiles. Sure-Weld Membrane may be heat welded directly to the coated metal. Coated metal is available in sheets 4' x 10' and comes packaged 25 sheets per pallet (also available packaged 10 sheets per pallet on a direct ship basis). Available in white, gray or tan. Also available in TPO Thermoplastics 7/2020 42 Special Colors (Medium Bronze, Rock Brown, Terra Cotta, Slate Gray and Patina Green) and comes packaged 5 sheets per pallet on a direct ship basis.
2. Sure-Flex PVC Coated Metal: A 24 gauge, galvanized steel sheet coated with a layer of non-reinforced Sure-Flex Flashing. The sheet is cut to the appropriate width and used to fabricate metal drip edges or other roof perimeter edging profiles. Sure-Flex Membrane may be heat welded directly to the coated metal. Coated metal is available in sheets 4' x 10' and comes packaged 10 sheets per pallet. Available in white, gray or tan.
3. Secur Edge 3000 Roof Edge System: A metal anchor bar fascia system consisting of a 20 gauge steel retainer bar, corrosion resistant fasteners and a 32, 40, 50 or 63-mil thick aluminum or 24 gauge steel snap-on fascia cover. It is for use in Fully Adhered and Mechanically Fastened Roofing Systems. ANSI/SPRI ES-1 certified. Also available in Secur Edge 3000XT Roof Edge System (Up to 13" Face Height).
4. Termination Bar: A 1" wide and 98-mil thick extruded aluminum bar pre-punched 6" on center which incorporates a sealant ledge to support Lap Sealant and provide increased stability for membrane terminations.
5. Secur Edge Term Bar Fascia: A 1.75" wide formed aluminum termination bar with pre-slotted fastening holes for ease of locating and installing. The decorative cover is available in 0.040" aluminum or 24-gauge galvanized steel. Secur Edge Term Bar Fascia is manufactured in 12' lengths for fewer joints/seams, fewer sections to handle and faster installation.
6. A 6 inch (14 cm) wide, smooth type, heat-weldable polyester scrim reinforced thermoplastic polyolefin membrane strip. Designed for use as a cover strip over non-coated metal edges and flanges. (Carlisle recommendation: Confirm)
7. .045" reinforced TPO membrane with pressure sensitive adhesive, to be installed on horizontal surfaces using plates and fasteners as a base attachment in fully adhered systems.
8. 24-gauge steel with 0.025" thick TPO based film as required for fabrication into metal gravel stop and drip edge profiles, metal base and curb flashings, sealant pans, and scupper sleeves. Standard sheet size 4' x 10', sheet weight 47 lbs

C. RELATED MATERIALS:

Sure-Weld Flashing (for use with Sure-Weld Adhered, Mechanically Fastened and Self Adhered Membrane Assemblies)

1. Sure-Weld Flashing: Sure-Weld non-reinforced flashing is available in rolls 12" and 24" wide by 50' long. Flashing is used for inside/outside corners and field fabricated pipe flashings when the use of premolded or pre-fabricated accessories is not feasible. In addition, 45-mil by 6" wide by 100' long, 60-mil by 6" wide by 100' long, 9" wide by 50' long and 80-mil by 9" wide by 50' long Sure-Weld reinforced membrane is available for overlaying fasteners and fastening plates.
2. Sure-Weld Pressure-Sensitive Cover Strip: A nominal 40-mil thick non-reinforced TPO membrane laminated to nominal 35-mil thick cured synthetic rubber pressure-sensitive adhesive used in conjunction with TPO Primer or Low-VOC TPO Primer to strip in flat metal flanges (i.e., drip edges). Available in rolls 6" wide by 100' long in colors of white, gray or tan. Not for use on 25-year or 30-year Warranty projects.
3. Sure-Weld TPO APEEL Cover Tape: A 6"-wide, 1,640' long roll of APEEL Protective Film used to protect areas of Sure-Weld TPO membrane where APEEL Protective Film has been removed (around details) or was not factory applied (seams). APEEL Cover Tape allows contractors to keep 100 percent of the TPO surface clean during installation and is applied using the APEEL Cover Tape Applicator.

4. Sure-Weld TPO Pressure-Sensitive RUSS: A nominal 6" and 10" wide, 45-mil thick reinforced TPO Thermoplastics 7/2020 35 membrane with nominal 3" wide 35-mil thick cured synthetic rubber pressure-sensitive tape adhesive laminated along one edge on 6" wide RUSS and along both edges on 10" wide RUSS. Used in conjunction with TPO Primer or Low-VOC TPO Primer. 6" wide RUSS is used as a base membrane securement along walls, curbs, etc.; 10" wide RUSS is used to form perimeter sheets on Mechanically Fastened Systems
5. Sure-Weld TPO T-Joint Covers: A 60-mil thick injection molded TPO flashing formed into a 4.5" diameter circle used to seal step-offs at splice intersections. Installation is mandatory on all 60, 72, and 80-mil TPO systems and on 45-mil systems where step-offs have not been properly sealed. Packaged in boxes of 100. Available in white, tan or gray
6. Sure-Weld TPO Contour Rib Profile: Used to obtain the appearance of standing seam metal roofing with the performance of a TPO single-ply membrane. The Contour Rib Profile measures 1-1/4" tall and 1-3/4" wide, including the welding flanges, while the vertical profile is a substantial 3/8" thick. The profile has a continuous 1/8" diameter alignment hole, for use with fiberglass connecting pins, as well as a 1/8" fiberglass reinforcing cord for added strength. The Contour Rib Profile is available in white, gray and tan, as well as Special Colors (Medium Bronze, Rock Brown, Terra Cotta, Slate Gray and Patina Green) in 10' lengths and packaged 20 per carton.

D. PRE-MOLDED ACCESSORIES:

1. Inside Corners: A pre-molded corner flashing for inside corners. Available in white, gray or tan; 60- mil thick
2. Outside Corners: A one-piece injection molded corner flashing used for flashing outside corners. Available in white, gray or tan; 60-mil thick
3. TPO Curb Wrap Corners: Fabricated flashings are made of 60-mil thick reinforced Sure-Weld Detail membrane designed to reduce installation time to flash a curb when compared to conventional methods. Each corner is fabricated with a 6" wide base flange and a 12" overall height. Four sizes are available to fit curbs up to 6' by 6' in size. One curb requires 4 corners for a complete installation. TPO Curb Corners are packaged in boxes containing twelve corners. Custom sizes are available as a special order product requiring lead time
4. TPO Universal Corners: a pre-molded flashing for use in a variety of corner details, including inside and outside corners. Available in white, gray and tan and are 60-mil thick.
5. Pipe Flashings: A pre-molded white, gray or tan pipe flashing used for pipe penetrations. Available for 3/4" –8" diameter pipes with clamping rings included
6. Split Pipe Seals: A prefabricated flashing consisting of 60-mil thick reinforced Sure-Weld Detail Membrane for pipes 1" – 6" in diameter. A split (cut) and overlapped tab are incorporated to allow the pipe seal to be opened and wrapped around the pipe when it is not possible to pull a standard pipe flashing over a round penetration. Custom sizes are available as a special order product requiring lead time
7. TPO Square Tubing Wraps: Fabricated flashings made of 60-mil thick reinforced Sure-Weld Detail membrane for square tubing. A split (cut) and overlap tab are incorporated into these parts to allow the seals to be opened and wrapped around a square penetration. Available for 3", 4", 5" and 6" square tubing
8. Molded TPO Sealant Pocket: A pre-fabricated, interlocking, 2-piece, injection molded, flexible pocket with a rigid polypropylene vertical wall and pre-formed deck flanges. Pockets can be adjusted from 11.5" to 7.5" in length by 6" in width by following the cutting lines molded into the pocket. Used in conjunction with White One-Part Pourable Sealer for waterproofing pipe clusters or other odd shaped penetrations. Available in white, gray or tan
9. Pre-fabricated Sealant Pocket: A two-piece, pre-fabricated sealant pocket that utilizes reinforced 60-mil TPO membrane and coated metal to form a rigid, oversized sealant pocket with a weldable horizontal deck flange. Available in 12" (total volume of 1.87 gallons). Packaged 2 per carton and available in white only. Refer to the applicable Technical Data Bulletin for dimensions and installation instructions. Custom sizes are available as special order product
10. Sealant Pocket Extension Legs: Designed for use with the TPO Molded Sealant Pocket and the Pre Thermoplastics 7/2020 36 Fabricated Sealant Pocket to extend the length in increments of 10". Fabricated

from 60-mil thick reinforced TPO membrane and TPO coated metal. Can be used full length, cut to size for customized lengths or welded to each other for extra long applications. Packaged 10 legs per carton and available in white only

2.8 ROOF WALKWAYS:

1. Walkways are to be specified at all traffic concentration points (IE: roof hatches, access doors, rooftop ladders, etc.) and if regular maintenance, once a month or more, is necessary to service rooftop equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that the surfaces and site conditions are ready to receive work.
- B. Verify that the deck is supported and secured.
- C. Verify that the deck is clean and smooth, free of depressions, waves, or projections, and properly sloped to drains, valleys, eaves, scuppers, or gutters.
- D. Verify that the deck surfaces are dry and free of ice or snow.
- E. Verify that all roof openings or penetrations through the roof are solidly set, and that all flashings are tapered.
- F. The substrate must be relatively even without noticeable high spots or depressions. Accumulated water, ice or snow must be removed to prevent the absorption of moisture in the new roofing components and roofing system.
- G. Prior to the placement of membrane underlayment, clear the substrate of debris and foreign material that may be harmful to the roofing system. Gaps greater than 1/4" must be filled with an appropriate material.

3.2 SUBSTRATE PREPARATION

- A. Steel Deck
 1. Metal decks must be a minimum uncoated thickness of 22 gauge (0.8 mm) and shall have a G-90 galvanized finish on all panels. FM requirements may supersede those set forth in this section. Consult the current FM Guide for more information.
 2. Decks must comply with the gauge and span requirements in the current Factory Mutual FM Approval Guide and be installed in accordance with Loss Prevention Data Sheet 1-28 or specific FM approval.
 3. When re-roofing over steel decks, surface corrosion shall be removed, and repairs to severely corroded areas made. Loose or inadequately secured decking shall be fastened, and irreparable or otherwise defective decking shall be replaced.
 4. Code standards apply when their requirements exceed those listed here.
 5. Withdrawal resistance tests are strongly suggested to determine the suitability of a roof deck. Refer to Design Reference DR-06-19 "Withdrawal Resistance Criteria" in the Carlisle Technical Manual proper procedures for conducting pullout tests
 6. Defects in the substrate must be reported and documented to the specifier, general contractor and building owner for assessment.

3.3 INSULATION - GENERAL

- B. Roof insulation thickness must be determined by the thermal value required for each project and may be subject to code approval limitations.
- C. Do not apply roof insulation or roofing until all other work trades have completed jobs that require them to traverse the deck on foot or with equipment. A vapor retarder coated lightly with asphalt may be applied to protect the inside of the structure prior to the insulation and final roofing installation. Before the application of the insulation, any damage or deterioration to the vapor retarder must be repaired.
- D. Do not install wet, damaged, or warped insulation boards.
- E. Do not install more insulation/underlayment than can be covered by membrane in the same day.
- F. Install insulation boards with staggered board joints in one direction (unless taping joint).
- G. All insulation boards must be butted together with no gaps greater than 1/4". Gaps greater than 1/4" are not acceptable
- H. Wood nailers must be 3-1/2" (8.9 cm) minimum width or 1" (25 mm) wider than metal flange. They shall be of equal thickness as the insulation and be treated for rot resistance. All nailers must be securely fastened to the deck.
- I. Do not kick insulation boards into place.
- J. Miter and fill the edges of the insulation boards at ridges, valleys, and other changes in plane to prevent open joints or irregular surfaces. Avoid breaking or crushing of the insulation at the corners.
- K. Insulation should not be installed over new lightweight insulating concrete.
- L. Do not install any more insulation than will be completely waterproofed each day.

3.4 INSULATION ATTACHMENT

A. General

- 1. Prior to proceeding with insulation securement refer to Warranty Tables, Paragraph 1.05, for attachment method and appropriate fastening density required for the specific Carlisle Warranty.

B. Adhered Roofing Systems:

- 1. Mechanical Attachment, insulation fastening density will vary based on insulation type, thickness, and required warranty. Warranty Tables in Paragraph 1.05 should be referenced for fastening density and the appropriate Carlisle detail may be consulted to identify acceptable fastening pattern.
- 2. For code compliance, increased fastening density may be required depending upon project wind speed and wind uplift requirement. Refer to Design Reference DR-05-19 "Insulation Fastening Patterns" for fastening pattern reference
- 3. When insulation securement is to comply with Factory Mutual (FM) approvals, follow the requirements of the specifier concerning additional securement at the roof perimeter and corners. Also refer to Design Reference DR-05-19 "Insulation Fastening Patterns" for various fastening patterns

C. Mechanically Fastened Roofing Systems:

- 1. Carlisle Fasteners and Fastening Plates are required for insulation securement. Refer to Insulation Fastening Criteria Table in Paragraph 2.05, for appropriate fastener and deck penetration. The fastener can

- be used with either a 2" diameter Seam Fastening Plate or 2-3/8" diameter Pirahna/Pirahna Extra Plates OR 3"diameter Insulation Fastening plate.
2. Any Carlisle approved insulation or cover board shall be mechanically fastened to the roof deck at the Thermoplastics 7/2020 49 minimum rate of 1 fastener and plate per every 8 square feet (4 fasteners in a 4 x 8 board) for warranties up to 15 year. Projects with 20 year or greater warranties require the use of 6 fasteners and plates in a 4' x 8' board (1 per 5.333 square feet).
 3. Use of DensDeck and DensDeck Prime should be limited to assemblies with slopes greater than 2" per foot to ensure compliance with external fire codes.

3.5 MEMBRANE PLACEMENT AND SECUREMENT

A. General:

1. Ensure that water does not flow beneath any completed sections of the membrane system by completing all flashings, terminations and daily seals by the end of each workday
2. Sweep all loose debris from the substrate
3. In addition to the primary membrane securement (Bonding for Adhered and Fastening for Mechanically Fastened Assemblies), additional membrane securement is required at the perimeter of each roof level, roof section, curb, skylight, interior wall, penthouse, etc., at any inside angle change where slope or combined slopes exceed 2" in one horizontal foot, and at other penetrations in accordance with the applicable Carlisle details

B. Membrane Placement:

1. Maximum 12' wide Sure-Weld or maximum 10' wide Sure-Flex Membrane is fully adhered or mechanically fastened to an approved insulation or substrate
2. Position Sure-Weld or Sure-Flex membrane over the acceptable substrate. For a mechanically fastened assembly, ensure proper number of perimeter sheets are positioned along the perimeter of the roof as outlined in Paragraph "Warranty Tables"
3. Position field sheets perpendicular to the steel deck flutes in Mechanically Fastened Applications.
4. Place adjoining membrane sheets in the same manner, overlapping edges appropriately to provide for the minimum overlap width. It is recommended all overlaps be shingled to avoid bucking of water

C. Membrane Securement / Bonding – Adhered Roofing System:

1. Adhere Sure-Weld or Sure-Flex membrane to an acceptable substrate with Carlisle Bonding Adhesive. CAVGRIP III low-VOC aerosol adhesive may be utilized with Sure-Weld TPO membranes. Comply with Labels, Safety Data Sheet (SDS) and Product Data Sheets for installation procedures and use. Adhesive must be applied to both the membrane and the surface to which it is being bonded
2. Fold membrane sheet back so half the underside is exposed. Sheet fold should be smooth without wrinkles or buckles
3. Stir Bonding Adhesive thoroughly scraping the sides and the bottom of the can (minimum 5 minutes stirring is recommended). Bonding surfaces must be dry and clean.
4. Apply Bonding Adhesive to the exposed underside of the membrane and the corresponding substrate area. Do not apply Bonding Adhesive along the splice edge of the membrane to be heat welded over adjoining sheet.
5. Allow adhesive to flash-off until it does not string but remains tacky to a dry finger touch
6. Roll the coated membrane into the coated substrate while avoiding wrinkles
7. Brush down the bonded section of the membrane sheet immediately after rolling the membrane into the adhesive with a soft bristle push broom to achieve maximum contact

8. Fold back the unbonded half of the sheet and repeat the bonding procedures. Apply Bonding Adhesive to the remaining exposed underside of membrane and adjacent substrate and complete this section as described above.
9. Install adjoining membrane sheets in the same manner, overlapping edges a minimum of 2 inches to provide for a minimum 1-1/2 inch heat weld. It is recommended that all splices be shingled to avoid bucking of water.

D. Membrane Securement / Fastening – Mechanically Fastened Roofing System:

1. Thermoplastic membranes shall be mechanically attached to the structural deck with specified Carlisle Fasteners and designated Plates
2. On steel decks, membrane shall be positioned with seams perpendicular to the steel deck flutes. This allows the external forces on the roof assembly to be distributed between multiple steel deck panels. Refer to Design Reference DR-06-19 "Withdrawal Resistance Criteria" in the Carlisle Technical Manual.
3. The number of perimeter sheets and fastener spacing is dependent on the building height, wind zone location and warranty duration as outlined in Warranty Tables in Paragraph 1.05.
The roof perimeter is defined as all edges of each roof section (i.e., parapets, building expansion joints at adjoining walls, penthouse walls, etc.). When multi-level roofs meet at a common wall, the adjacent edge of the upper roof is treated as a roof perimeter if the difference in height is greater than 10'. Perimeter sheets are not required at the base of the wall at the lower level.
Note: Expansion joints, control joints and fire walls in the field of the roof or roof ridges with slopes less than 3" to the horizontal foot are not considered as part of the roof perimeter.
For Sure-Weld membranes, perimeter sheets can be formed by using individual 4' to 6' wide sheets or by subdividing 8' or 10' wide field sheet using 10" wide Pressure-Sensitive RUSS strip or row of seam fastening plates as described below. For Sure-Flex membranes, perimeter sheets can be formed by using individual 40.5" or 5'-0" wide sheets
4. RUSS - Reinforced Universal Securement Strip Method (Sure-Weld Membrane Only)
 - a. When field sheets are positioned parallel to a roof perimeter, 10" wide Sure-Weld Pressure Sensitive RUSS (with 3" wide tape each side) shall be placed approximately down the center of the 8'-0", 10'-0" or 12'-0" wide Sure-Weld TPO field membrane sheets. When a RUSS divides a field sheet in half, two perimeter sheets are created
 - b. When field membrane sheets extend perpendicular to the edge of the roof, position the 10" wide Sure-Weld Pressure-Sensitive RUSS beneath the membrane along the center of each field sheet extending a distance equal to 0.4 times the building height to create perimeter sheets

E. Fastening Plates Method:

In lieu of the RUSS securement method, position a row of seam fastening plates in the locations identified in Paragraph 4.b.1 and 4.b.2, secure plates with appropriate fastener and overlay plates with 6" wide Pressure-Sensitive Sure-Weld Cover Strip (TPO Only) overlay the plates as follows:

1. Sure-Weld Installation – Warranties Up to 20 Years - 6" wide Pressure Sensitive Sure-Weld Cover Strip or 6" wide Sure-Weld membrane centered over the plates and heat welded to the field membrane. Seal cut edges of TPO overlay with TPO Cut-Edge Sealant to seal any exposed scrim, cut edge sealant is not required for PVC or KEE HP PVC
2. Projects with Warranties greater than 20 Years OR Sure-Flex projects regardless of warranty duration center 6" wide section of TPO/PVC/KEE HP PVC membrane (equal thickness to the deck membrane) over the plates and heat weld the field sheets. All cut edges of TPO overlay must be sealed with TPO Cut-Edge Sealant to seal any exposed scrim, cut edge sealant is not required for PVC or KEE HP PVC
3. Buildings with overhangs:
The membrane must be specified with perimeter sheets installed over the entire overhang area extending onto the main roof deck when at the same level. As an option, an adhered membrane section may be used in

lieu of the mechanically fastened membrane at building overhangs in accordance with the Carlisle Specification for the Sure-Weld/Sure-Flex Adhered Roofing System

F. Field Membrane:

1. Position adjoining field membrane sheets to allow an approximate overlap of 5-1/2" at those locations where Fastening Plates are located (along the length of the membrane); at the same time overlap end roll sections (the width of the membrane) a minimum of 2"
2. Secure the membrane at the approved fastening density with the required Carlisle Fastener and Fastening Plates
3. For installation of membrane with fullness, tighten the sheet between fasteners as follows:
 - 1) Unroll sheets and position. Thermoplastics 7/2020 53
 - 2) Place a fastener and plate in one end of the sheet on the appropriate fastener mark. Go to the opposite end of the sheet, pull it tight and place a fastener and plate at the appropriate mark. Place the remaining fasteners into the sheet.
 - 3) Proceed to weld the sheet in place and continue across the roof.
4. Prevention of membrane distortion during windy conditions:
 - 1) Unroll sheet approximately 5' and position edge of membrane with overlap line on adjacent sheet
 - 2) Install fasteners along the 5' exposed edge
 - 3) While the 5' of exposed membrane is being fastened, begin welding the overlapped edge using the Automatic Heat Welder
 - 4) As sheet is being welded and fastened concurrently, unroll membrane. Unroll only enough membrane to stay a few feet ahead of welding and fastening process. This reduces amount of unsecured membrane to be distorted by wind
 - 5) Continue this process for each adjoining sheet

G. Additional Membrane Securement:

1. Securement must be provided at the perimeter of each roof level, roof section, expansion joint, curb, skylight, interior wall, penthouse, etc., at any inside angle change where slope exceeds 2 inches to one horizontal foot, and at all penetrations as identified on the Carlisle details
2. Securement may be achieved as follows:
 - a. On Mechanically Fastened Roofing Systems, Carlisle's Piranha Fastening Plates are used to secure the membrane with the appropriate Carlisle Fastener at the base of walls and penetrations and flashed as shown on the applicable Carlisle detail (excluding OSB, cementitious wood fiber and gypsum decks where the required Carlisle Fastener is installed with the associated 2" diameter plate). On Adhered Roofing Systems, Carlisle standard 2" diameter Seam Fastening Plates may be used in lieu of Piranha Plates.
 - b. Securement of the membrane shall be a maximum of 12 inches on center. Fasteners shall be positioned 6 inches minimum to 9 inches maximum from the inside or outside corner.
 - c. On Mechanically Fastened assemblies, additional membrane securement is required around pipes and sealant pockets as shown on the applicable detail. The plates must be positioned a maximum of 12" away from the penetration, spaced a maximum of 12" on center and flashed in accordance with the applicable Thermoplastics 7/2020 54 Carlisle Detail.
 - d. After securing the membrane, flash in accordance with the appropriate detail

3.6 HEAT WELDING PROCEDURES

A. General:

1. APEEL Protective Film should be removed from within areas that are to be heat-welded together. In areas that do not require heat welding, the APEEL Protective Film can be left in place for up to 90 days
2. Heat weld the Sure-Weld or Sure-Flex membrane sheets using the Automatic Heat Welder or Hot Air Hand Welder and silicone roller

3. Check the surfaces of the membrane to be heat welded to ensure they are properly prepared. The surfaces to be heat welded must be clean. Membrane overlaps that become contaminated with field dirt must be cleaned with Weathered or PVC and KEE HP Membrane Cleaner (Weathered Membrane Cleaner should not be used to clean Sure-Flex PVC or KEE HP). Weathered or PVC and KEE HP Membrane Cleaner should be wiped dry with a clean HP Splice Wipe prior to welding. No residual dirt or contaminants should be evident

B. Membrane Welding:

1. Prepare the Automatic Heat Welder and allow it to warm for approximately 5 to 10 minutes to reach operating temperature
2. Position the Automatic Heat Welder properly prior to seaming with the guide handle pointing in the same direction the machine will move along the seam
3. Lift the overlapping membrane sheet and insert the blower nozzle of the Automatic Heat Welder between the overlap. Machine will begin moving along the seam immediately
4. Weight plates provided on Automatic Welders must be utilized
5. Proceed along the seam ensuring that the small guide wheel in front of the machine aligns with the edge of the top membrane sheet. Guide the machine from the front only
6. At all splice intersections, roll the seam with a silicone roller to ensure a continuous heat welded seam (the membrane should be creased into any membrane step-off with the edge of the silicone roller). A false weld may result due to surface irregularities created by multiple thicknesses of Sure-Weld/Sure-Flex membrane sheets.
When using 60-mil or 80-mil Sure-Weld or 80-mil Sure-Flex Membrane, a TPO/PVC "T"-Joint Cover must be applied over all "T" joint splice intersections. The use of Sure-Flex Non-Reinforced Flashing is not acceptable as an overlay due to its thickness (60-mil). Reinforced membrane regardless of thickness should not be used since a water tight seal will not be obtainable. Sure-Flex 'T'-Joint is the only acceptable 'T'-Joint cover permitted by Carlisle
7. To remove the Automatic Heat Welder from the finished splice, disengage and pull the nozzle from the seam area, the machine will stop automatically.
8. Mark the end of the heat welded seam with a water-soluble marker for easy identification. A Hand Held Welder will be necessary to complete the weld in the area between where the Automatic Heat Welder is stopped and restarted.
9. Perform a test weld, at least, at the start of work each morning and afternoon. Test welds should be made if any changes in substrate or weather conditions occur.

C. Seam Sealing:

1. Apply **Cut-edge Sealant** on all cut edges of the reinforced Sure-Weld membrane (where the scrim reinforcement is exposed) **after seam probing** is completed. When a 1/8" diameter bead of TPO Cut-Edge Sealant is applied, approximately 225 – 275 linear feet of coverage per squeeze bottle can be achieved.
 - a) Cut-Edge Sealant is not required on cut edges of Sure-Flex membrane (Horizontal or Vertical).
 - b) Cut-Edge Sealant is not required on vertical Sure-Weld splices

3.7 FLASHINGS

A. General:

1. The height of new wall flashing must extend above the anticipated water level or slush line.
2. Flash all perimeter, curb, and penetration conditions with coated metal, membrane flashing, and flashing accessories as appropriate to the site condition.
3. All coated metal and membrane flashing corners shall be reinforced with preformed corners or non-reinforced membrane.
4. Hot-air weld all flashing membranes, accessories, and coated metal. A minimum 2" wide (hand welder) weld or minimum 1 - 1/2" automatic machine weld is required.
5. On 15 or 20-year Warranty projects, Carlisle's Termination Bar, in conjunction with Water Cut-Off Mastic, must be specified under all metal counterflashings and surface mounted reglets
6. To comply with various warranty options, flashing material must equal the required minimum membrane thickness but shall not be less than 60-mils thick. For projects with 20 year or greater warranties Carlisle PreFabricated accessories must be used unless prohibited by a specific field condition
7. Flashing of parapets, curbs, expansion joints and other parts of the roof must be performed using SureWeld/Sure-Flex reinforced membrane. Sure-Weld/Sure-Flex non-reinforced membrane can be used for flashing pipe penetrations, Sealant Pockets and scuppers as well as inside and outside corners when the use of pre-molded accessories is not feasible
8. When possible, all reinforced membrane splices are heat welded with the Automatic Heat Welder. The Hand Held Hot Air Welder should be utilized in hard to reach areas, smaller curbs, vertical splices and when using non-reinforced membrane.
 - a. The new Sure-Weld/Sure-Flex membrane flashing must not conceal weep holes or cover existing throughwall flashing.
 - b. Install surface mounted reglets and compression bar terminations directly to the wall surface
9. In areas where metal counterflashing or surface mounted reglets are used as vertical terminations, the counterflashing must be sealed with a rubber grade caulking to prevent moisture migration behind the new wall flashing.

B. Application of Bonding Adhesive:

1. Membrane shall be adhered to vertical surfaces with Sure-Weld/Sure-Flex Bonding Adhesive. CAV-GRIP III low-VOC aerosol adhesive may be utilized with Sure-Weld TPO membranes. Bonding Adhesive shall be applied continuously, without globs or puddles.
2. After the Bonding Adhesive has properly dried, roll the membrane into the adhesive
3. Care must be taken when setting the flashing to avoid bridging greater than 3/4 inch at angle changes (i.e., where a parapet or roof penetration meets the roof deck). This can be accomplished by creasing the membrane into the angle change
4. Terminate the edges of the installed membrane in accordance with Carlisle's applicable details
5. When using TPO membrane flashing only, bonding adhesive is not required when the flashing height is 12" or less. When Carlisle termination bar is used beneath the counter-flashing, bonding adhesive can be eliminated when the flashing height is 18" or less

C. Walls, Parapets, Curbs, Skylights, etc:

1. The flashing height must be calculated so that the Sure-Flex membrane flashing includes a minimum 1-1/2 inch heat weld beyond the Fastening Plates.
2. Fasten at angle change as identified in Paragraph 3.08, Additional Membrane Securement, with the required Carlisle Fastener and plate.
3. Flash the fasteners/plates with a separate piece of Sure-Weld/Sure-Flex reinforced membrane; apply heat and crease the flashing into the angle change before attaching it to the vertical surface

D. Metal Edge Terminations:

1. Factory-fabricated metal edge systems must be secured to the wood nailer as specified by the manufacturer. Shop-fabricated edging must be installed in compliance with appropriate Carlisle Detail using Carlisle TPO/PVC Coated Metal in order to achieve ES-1 Compliance. Refer to the appropriate Universal Details for other flashing options and requirements.

E. Roof Drains:

1. Sure-Weld/Sure-Flex membrane may extend into the drain sump when the slope of the sump is less than 3" to one horizontal foot.
2. When the drain sump is greater than 3" to one horizontal foot, additional membrane securement must be installed.
3. Only drain strainers that have been approved by the specifier in accordance with applicable codes may be used.

F. Other Penetrations:

1. On Mechanically Fastened assemblies, additional membrane securement is required around pipes and sealant pockets as shown on the applicable detail. The plates must be positioned a maximum of 12" away from the penetration, spaced a maximum of 12" on center and flashed in accordance with the applicable Carlisle Detail
2. Pipes, Round Supports, etc.
 - a. Flash pipes with Molded Pipe Flashings or Split Pipe Seals where their installation is possible. Molded pipeflashings cannot be cut and patched; deck flanges cannot be overlapped or installed over angle changes.
 - b. Where Molded Pipe Flashings or Split Pipe Seals cannot be installed, APPLY FIELD FABRICATED PIPE FLASHING using Sure-Weld/Sure-Flex non-reinforced membrane.
3. Flexible Penetrations (braided cables, conduits, wires, etc.) must be enclosed in a stable "goose neck." Apply a Split Pipe Seal or field fabricated pipe flashing to flash the goose neck
4. Hot pipes that exceed 140° F (60° C) (PVC/KEE HP PVC) and 160° F (71° C) (TPO), must utilize an insulated metal collar and rain hood, flashed with a field fabricated pipe flashing.
5. For pipe clusters or unusually shaped penetrations, a Molded Sealant Pocket and White One Part Sealant must be utilized
6. Flashing of Difficult Penetrations, refer to Spec Supplement G-13-20 for "LIQUISEAL Liquid Flashing" for additional information and specific requirements

G. Daily Seal:

1. On phased roofing, when the completion of flashings and terminations is not possible by the end of each workday, provisions must be taken to temporarily close the membrane to prevent water infiltration. Refer to Spec Supplement G-07-20 "Daily Seal & Clean Up"

H. Roof Drains:

1. Roof drains must be fitted with compression type clamping rings and strainer baskets. Original-type cast iron and aluminum drains, as well as retrofit-type cast iron, aluminum or molded plastic drains are acceptable.
2. Roof drains must be provided with a minimum 36" x 36" sump. Slope of tapered insulation within the sump shall not exceed 4" in 12".
3. Extend the roofing membrane over the drain opening. Locate the drain and cut a hole in the roofing membrane directly over the drain opening. Provide a 1/2" of membrane flap extending past the drain flange into the drain opening. Punch holes through the roofing membrane at drain bolt locations.
4. For cast iron and aluminum drains, the roofing membrane must be set in a full bed of water block on the drain flange prior to securement with the compression clamping ring. Typical water block application is one 10.5-ounce cartridge per drain.

5. Lap seams shall not be located within the sump area. Where lap seams will be located within the sump area, a separate roof membrane drain flashing a minimum of 12" larger than the sump area must be installed. The roof membrane shall be mechanically attached 12" on center around the drain with screws and plates. The separate roof drain flashing shall be heat welded to the roof membrane beyond the screws and plates, extended over the drain flange, and secured as above.
6. Tighten the drain compression ring in place.

3.8 TRAFFIC PROTECTION

- A. Install walkway rolls at all roof access locations and other designated locations including roof-mounted equipment work locations and areas of repeated rooftop traffic.
- B. Walkway pads must be spaced 2" apart to allow for drainage between the pads.
- C. Heat-weld walkway rolls to the roof membrane surface continuously around the perimeter of the roll.
- D. Walkways are to be specified at all traffic concentration points (i.e., roof hatches, access doors, rooftop ladders, etc.), and if regular maintenance (once a month or more) is necessary to service rooftop equipment. Refer to Spec Supplement G-06-19 "Roof Walkway Installation"
- E. Walkway rolls may be installed with TPO primer and 3" seam tape.
 1. Roll or brush the TPO primer on the back of the TPO pad along the edges and down the middle length of the pad.
 2. Clean and prime the roof membrane where the pad will be installed.
 3. Install tape to the back of the cleaned area of the pad and roll in with a silicone hand roller.
 4. Remove release paper and install the tapes pads directly onto the roof membrane. Roll pads to secure in place

3.9 ROOF PROTECTION

- A. Protect all partially and fully completed roofing work from other trades until completion.
- B. Whenever possible, stage materials in such a manner that foot traffic is minimized over completed roof areas.
- C. When it is not possible to stage materials away from locations where partial or complete installation has taken place, temporary walkways and platforms shall be installed in order to protect all completed roof areas from traffic and point loading during the application process.
- D. Temporary tie-ins shall be installed at the end of each workday and removed prior to commencement of work the following day.

3.10 CLEAN-UP

- A. All work areas are to be kept clean, clear, and free of debris always.
- B. Do not allow trash, waste, or debris to collect on the roof. These items shall be removed from the roof daily.
- C. All tools and unused materials must be collected at the end of each workday and stored properly off the finished roof surface and protected from exposure to the elements.
- D. Dispose of or recycle all trash and excess material in a manner conforming to current EPA regulations and local laws.

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- E. Properly clean the finished roof surface after completion, and make sure the drains and gutters are not clogged.
- F. Clean and restore all damaged surfaces to their original condition.

END OF SECTION

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formed roof-coping sheet metal fabrications.
 - 2. Formed wall sheet metal fabrications.
 - 3. Miscellaneous sheet metal flashing.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For sheet metal flashing and trim.
- C. Samples: For each exposed product and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1.6 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
 - 1. Exposed Coil-Coated Finish at Locations Shown on Plans:
 - a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation; prepainted by coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color: As selected by Architect from manufacturer's full range.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials: WIP 300HT.
 - b. Grace Construction Products, a unit of W.R. Grace & Co. –Conn.; Grace Ice and Water Shield HT, Ultra.
 - c. Owens Corning; WeatherLock Specialty Tile and Metal Underlayment.
 - d. Polyguard Products, Inc.; Deck Guard HT.
 - 2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.

3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, underlayments, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 1. Obtain field measurements for accurate fit before shop fabrication.
 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
- C. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

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- E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot-(3.6-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners shall be fastened and sealed to be watertight. Shop fabricate interior and exterior corners.

- 1. Fabricate from the following materials:
 - a. Metallic-Coated Sheet Steel: 0.028 inch thick.

2.7 WALL SHEET METAL FABRICATIONS

- A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
 - 1. Aluminum sheet exposed coil-coated finish: 0.032 inch thick.
 - 2. Metallic-coated Sheet Steel: 0.028 inch thick where shown on plans.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment Where Shown on Plans: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.

- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.3 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
- C. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.4 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.5 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux material at stainless steel countertops and clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

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END OF SECTION 076200

SECTION 078413 – PENETRATION FIRESTOPPING

1.1 SUMMARY

- A. Section Includes:
1. Requirements for furnishing and installing firestopping for fire-rated construction at the following locations:
 - a. Penetrations through fire-rated walls including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
 - b. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.
 - c. Architectural/Construction joint firestops within walls, or the intersection of floors to exterior walls, or the intersection of top of walls to ceilings.
 - d. Top of wall firestopping in all fire-rated partitions.
 - e. Top of wall and construction joint smoke-stopping in all smoke partitions.
- B. Related Sections:
1. Section 033000 - Cast-in-place Concrete.
 2. Section 079200 - Joint Sealants: Non-fire-resistive-rated joint sealants.
 3. Section 092900 - Gypsum Board Assemblies: Gypsum board fireproofing and for partition identification (stenciling fire-rated walls).
 4. DIVISION 21-23: Sections specifying duct and piping penetrations.
 5. DIVISION 26-28: Sections specifying cable and conduit penetrations.

1.2 REFERENCES

- A. Reference Standards: The Reference Standards listed below refer to the latest date of issue or edition, unless otherwise indicated.
1. ASTM E 814: Standard Method of Fire Tests of Through-Penetration Firestops.
 2. ASTM E119: Standard Method of Fire Tests of Building Construction and Materials.
 3. UL 1479: Fire Test of Through-Penetration Firestops.
 4. UL 723: Surface Burning Characteristics of Building Materials.
 5. UL 2079: Standard for Tests for the Fire Resistance of Building Joint Systems.
 6. Published Through-Penetration and Joint Systems by recognized independent testing agencies:
 - a. UL (Underwriters Laboratories Inc.) Fire Resistance Directory (volume 2&3).
 - b. Warnock Hersey Certification Listings, current year.
 - c. Omega Point Laboratory, current year.
 - d. Factory Mutual, current year.

1.3 DEFINITIONS

- A. Definitions: As used in this Section, the following definitions apply:
1. Firestop systems: Complete, tested assemblies including wall/floor construction, penetrating items, and field-applied materials designed to prevent the spread of fire through openings.
 2. Firestop devices: Factory-built products designed to resist the spread of fire through floor and wall openings, and require only assembly and installation at the project site.
 3. Firestopping: Field-applied component materials of firestop systems, which form the seal against spreading fire.
 4. Smoke seal systems: Systems designed to stop the spread of smoke through smoke walls. To be a smoke seal system, the system must have at least a one-hour fire-rating.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide firestop systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases.
- B. F-Rated Systems: Provide firestop systems with F ratings indicated, as determined per ASTM E 814 and UL 1479, but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.
- C. T-Rated Systems: Provide firestop systems with T ratings, in addition to F ratings, as determined per ASTM E 814 and UL 1479, where any of the following conditions exist:
 - 1. Penetrations that incorporate penetrating items that is in contact with combustible materials in acceptable areas.
 - 2. Penetrations that is located outside of wall cavities and fire-resistive shaft enclosures.
 - 3. Penetrations that are located in construction containing doors required to have a temperature rise rating.
 - 4. Penetrations that incorporate penetrating items larger than a 4 inch diameter nominal pipe or 16 sq. in. in overall cross-sectional area.
- D. Special Conditions: For firestopping exposed to traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant firestop systems.
 - 2. For penetrations involving insulated piping, provide firestop systems not requiring removal of insulation.
 - 3. For firestopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E 84.

1.5 SUBMITTALS

- A. Submit the following:
 - 1. List of proposed firestop systems with system drawings, arranged according to construction type and penetrating items, with design designation of firestop systems proposed, as listed by UL, Warnock Hersey, Omega Point Laboratory, Factory Mutual or other qualified testing and inspection agency.
 - 2. Testing and inspection agencies complete design designation description and drawings of firestop systems proposed.
 - 3. Manufacturer's product specifications and application recommendations for each product are to be used.
 - 4. Material Safety Data Sheets (MSDS) for each firestop product used.
 - 5. Qualifications: Submit letter from firestop manufacturer approving installer as qualified to install the specified firestop products.

1.6 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Comply with the following requirements in addition to those specified under "System Performance Requirements" in PART 1 of this Section.
 - 1. Provide systems that have been tested by UL, Warnock Hersey, Omega Point or by another qualified testing and inspecting agency acceptable to authorities having jurisdiction, and that correspond to design designation listings published by the testing agency.
 - 2. Provide systems tested per ASTM E 814 under conditions where positive furnace pressure differential of at least 0.01 inch of water is maintained at a distance of 0.78 inch below the fill materials surrounding the penetrating items in the test assembly.
 - 3. Provide firestopping products that bear the classification marking of qualified testing and inspecting agency.
- B. Installer Qualifications: Engage an experienced Installer who has completed firestopping that is similar in material, design, and extent to that indicated for Project and that has performed successfully.
- C. Single Source Responsibility: Obtain firestopping for each type of penetration and construction condition from a single manufacturer.

- D. Firestopping Contractor Qualifications: Due to life safety considerations, all firestopping applications shall be performed by a single specialty contractor that is trained and licensed specifically in this discipline. Said contractor will be used to install firestopping in all disciplines. To ensure consistency, quality and proper installations, application of firestopping products by any other contractor or subcontractor will not be acceptable. Firestopping contractor's personnel shall have received specific training and certification or approval from the proposed firestop material manufacturer and shall have a minimum of two (2) years experience installing firestop systems of the type specified in this Section.
- E. Selection: Contractor shall select firestop systems, based on information in the Contract Drawings and on conditions that are expected to exist during installation, from the acceptable types specified in this Section, to satisfy all of the following criteria:
 - 1. Systems shall meet or exceed the required fire-resistance-rating of the construction involved at each penetration.
 - 2. Systems shall be rated for installation in the type of construction involved at each penetration.
 - 3. Systems shall be rated for use in conjunction with penetrating items of the type, size, and number involved at each penetration.
- F. Asbestos: Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."
- G. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are installed per specified requirements.
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements of "Section 01314 - Project Meetings".
- I. Engineering Judgments: For those firestop applications that exist for which no approved tested system is available through a manufacturer, an engineering judgment derived from similar system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994, as may be amended from time to time) and be provided via approved manufacturer.

1.7 MOCK-UPS

- A. Job Mock-Ups: Prepare job mock-up of the material proposed for use in the project as directed by Architect. Approved mock-ups may be left in place as part of the finished project and shall constitute the standard for remaining work, including aesthetics.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multi-component materials.
- B. Storage and Handling: Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.9 PROJECT CONDITIONS

- A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilation: Ventilate application areas per firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

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- C. Sequencing and Scheduling: Commence firestopping in each location after penetrating items are complete and tested but prior to concealing the openings.
 - 1. Firestopping shall precede gypsum board finishing.
- D. Agency Inspections: Do not conceal firestopping installations behind other construction until authorities having jurisdiction, if required, have examined each installation.
- E. Existing Construction: Include firestopping at newly formed penetrations and at existing unprotected penetrations, which are disclosed during performance of the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approved Firestopping Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include but are not limited to the following:
 - 1. 3M Company.
 - 2. Spec Seal (Specified Technologies Inc. - STI)
 - 3. The Rectorseal Corporation (Bio Fireshield & Metacaulk).
 - 4. Hilti, Inc. 1-800-879-8000
 - 5. Tremco Inc. 1-800-321-7906
- B. Approved Firestopping Contractors: Subject to compliance with requirements, firestopping applications shall be performed by the following contractors (other contractors will require pre-bid approval):
 - 1. Firestop International, L.L.C. 504-832-3190
 - 2. Acadian Firestopping of Lafayette, Inc. Phone: 1-337-981-0621, Fax: 1-337-981-0644
 - 3. J-Kaulk Firestopping, Carriere, MS., Phone: (601) 798 – 0828

2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide components that are compatible with each other, the substrates forming openings, and the penetrating items, if any, under conditions of service and application, as demonstrated by firestopping manufacturer's testing and field experience.
- B. Accessories: Provide accessory components for each firestopping system specified by the firestopping manufacturer and approved for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:
 - 1. Permanent forming/damming/backing materials including the following:
 - a. Semi-refractory fiber (mineral wool) insulation.
 - b. Ceramic fiber.
 - c. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - d. Fire-rated formboard.
 - e. Joint fillers for joint sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Metal collars and sleeves.

2.3 FIRESTOPPING MATERIALS

- A. Firestop Mortars:
 - 1. Hilti, Inc." FS 635 mortar"
 - 2. 3M "Fire Barrier Mortar".
 - 3. Spec Seal "Fire Rated Mortar"
 - 4. Metacaulk or Bio Shield "Fire Rated Mortar"
 - 5. Tremco Inc. "Tremstop M"

- B. Firestop Sealants and Caulks:
 - 1. Hilti, Inc. "Intumescent and Non-Intumescent sealants", consisting of FS-one, CP-606, and CP-601S
 - 2. 3M "Intumescent and Non-Intumescent Caulks".
 - 3. Spec Seal "Intumescent and Non-Intumescent Caulks".
 - 4. Rectorseal "Intumescent and Non-Intumescent Caulks"
 - 5. Spec Seal "Electrometric Sealant."
 - 6. 3M "Electrometric Sealant."
 - 7. Tremco Inc. "Intumescent and Non-Intumescent Sealants"

- C. Firestop Putty:
 - 1. Hilti, Inc. "Fire Rated Putty and Putty Pads", consisting of CP-618 putty stick and CP-617 putty pads.
 - 2. 3M "Fire Rated Putty and Putty Pads".
 - 3. Spec Seal "Fire Rated Putty and Putty Pads".
 - 4. Rectorseal "Fire Rated Putty and Putty Pads".
 - 5. Tremco, Tremstop MP

- D. Fire Barrier Sheet Material:
 - 1. CS "195 + composite sheet" or approved equal

- E. Firestop Plastic Pipe Devices:
 - 1. Hilti, Inc. "Intumescent Collars"
 - 2. 3M "Plastic Pipe Devices".
 - 3. Spec Seal "Intumescent Collars".
 - 4. Rectorseal "Intumescent Collars".
 - 5. Tremco, Inc. "Fyre-Can/Sleeve"

- F. Intumescent Wrap Strips:
 - 1. Hilti, Inc. "Intumescent Wrap Strips"
 - 2. 3M "Intumescent Wrap Strips".
 - 3. Spec Seal "Intumescent Wrap Strips".
 - 4. Rectorseal "Intumescent Wrap Strips".
 - 5. Tremco, Inc. "Tremstop WS"

- G. Firestop Mastic and Wrap Materials:
 - 1. Hilti, Inc. "Speed Spray", mastic.
 - 2. 3M "Mastic Sprays".
 - 3. Spec Seal "Mastic Sprays".
 - 4. Rectorseal "Mastic Sprays"
 - 5. Spec Seal "Electrometric Spray"
 - 6. 3M "Electrometric Spray"

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7. 3M “Duct Wrap and Plenum Wraps”.
 8. Spec Seal “Duct Wrap and Plenum Wraps”.
 9. Rectorseal “Duct Wrap and Plenum Wraps”.
 10. Tremco, Inc. Tremstop “Acrylic-SP”
- H. Firestop Pillows:
1. Hilti, Inc. “Fire Block”, FS-657
 2. Spec Seal “Firestop Pillows”.
 3. Rectorseal “Firestop Pillows”.
 4. Tremco, Inc. “Tremstop PS”
- I. Sealants, caulking or spray materials for use with fire-rated construction joints,
For openings between structurally separate sections of wall and floors,
And other gaps, the following products are acceptable:
1. Hilti, Inc. “Speed Spray”-CP-672
 2. Hilti, Inc. CP_601S, Electrometric Firestop Sealant
 3. Hilti, Inc. CP-606, Flexible Firestop Sealant
 4. Tremco “Fyre-Sil”
 5. Equivalent products listed in the U.L. Fire Resistance Directory-Volume 2
- J. Cast – In Place Firestop Device for use with non-combustible and combustible
Plastic pipe (closed and open piping systems) penetrating concrete floors, the following products are
acceptable:
1. Hilti, Inc. “CP-680 cast – in place
 2. Tremco, Inc. “Tremstop Fyre-Can”
 3. Equivalent products listed in the U.L. Fire Resistance Directory- Volume 2

2.4 ACCESSORIES

- A. Forming/Damming Materials: Mineral fiberboard, or other type, is recommended by firestopping manufacturer.
- B. Primer, Sealant and Solvent Cleaner: Types as recommended by firestopping manufacturer.

2.5 MIXING

- A. General: For those products requiring mixing prior to application, comply with firestopping manufacturer's directions to produce firestopping products of uniform quality for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Examination: Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected, and penetrating items are complete and tested.
- B. Environmental Conditions: Verify that environmental conditions are safe and suitable for installation of firestop products.

3.2 CONDITIONS REQUIRING FIRESTOPPING

- A. General: Provide firestopping for conditions specified whether or not firestopping is indicated, and if indicated, whether such material is designed as insulation, safing, or otherwise.
- B. Through-Penetrations: Firestopping shall be installed in all open penetrations and in the annular space in all penetrations in any bearing or non-bearing fire-rated barrier.
- C. Membrane-Penetrations: Where required by code, all membrane-penetrations in rated walls shall be protected with firestopping products that meet the requirements of third party time/temperature testing.
- D. Construction Joints/Gaps: Firestopping shall be provided at the following locations:
 - 1. Between the edges of floor slabs and exterior walls
 - 2. In the control joint in masonry walls and floors
 - 3. In expansion joints
- E. Smoke-Stopping: Smoke-Stops shall be provided for Through-Penetrations, Membrane-Penetrations, and Construction Gaps with a material approved and tested for such application as required by other Sections as listed in 1.1. B "Related Sections".

3.3 INSTALLATION

- A. General: Installation of firestops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
 - 1. Apply firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
 - 2. Coordinate with plumbing, mechanical, electrical and other trades, to assure that all pipe, conduit, cable, and other items, which penetrate fire-rated construction have been permanently installed prior to installation of firestops. Schedule and sequence the work to assure that partitions and other construction, which would conceal penetrations are not erected prior to the installation of firestops.
 - 3. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.
 - 4. Seal holes and penetrations to ensure an effective smoke seal.
 - 5. In areas of high traffic, protect firestopping materials from damage. If the opening is large, install firestopping materials capable of supporting the weight of a human.
 - 6. Insulation types specified in other Sections shall not be installed in lieu of firestopping material specified herein.
 - 7. All combustible penetrants (e.g. non-metallic pipes or insulated metallic pipes) shall be firestopped using products and systems tested in a configuration representative of the field condition.
- B. Dam Construction: When required to properly contain firestopping materials within openings, damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Noncombustible damming materials may be left as a permanent component of the firestop system.

3.4 FIELD QUALITY CONTROL

- A. Maintain onsite copy of submittal package including system drawings.
- B. Prepare and install firestopping systems in accordance with manufacturer's printed instructions and recommendations.
- C. Follow safety procedures recommended in the Material Safety Data Sheets.

- D. Finish surfaces of firestopping, which are to remain exposed in the completed work to a uniform and level condition.
- E. Accessibility: All areas of work must be accessible until inspection by the applicable Code Authorities.
- F. Correct unacceptable firestops and provide additional inspection to verify compliance with this specification at no additional cost.

3.5 CLEANING

- A. Cleaning: Remove excess firestopping materials as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.

3.6 PROTECTION

- A. Protection: Protect firestopping during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so that firestop systems are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestop systems complying with specified requirements.

3.7 SYSTEMS AND APPLICATIONS SCHEDULES (FOLLOWING PAGES)

Schedule of UL through Penetration Firestop Systems

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| CONCRETE FLOORS | | UL-CLASSIFIED SYSTEMS | | | | CONCRETE OR BLOCK WALLS | | UL-CLASSIFIED SYSTEMS | | | |
|--|---------------|-----------------------|---|------------------------------|---------------------------------------|--|----------|-----------------------|--------------------------------------|------------------------------|------------------------------|
| TYPE PENETRATION | F-RATING (HR) | STI | HILTI | 3M | TREMCO | TYPE PENETRATION | F-RATING | STI | HILTI | 3M | TREMCO |
| CIRCULAR BLANK OPENINGS | 1 | CAJ 0014 | FA 0006, CAJ 0070 | CAJ 0009 | CAJ 0011 | CIRCULAR BLANK OPENINGS | 1 | CAJ 0014 | CAJ 0055, CAJ 0070 | CAJ 0009 | CAJ 0011 |
| | 2 | CAJ0014 | FA 0006, CAJ 0070 | CAJ 0009 | CAJ 0011 | | 2 | CAJ 0014 | CAJ 0055, CAJ 0070 | CAJ 0009 | CAJ 0011 |
| | 3 | CAJ0014 | CAJ 0055 | CAJ 0009 | N/A* | | 3 | CAJ 0014 | CAJ 0055 | CAJ 0009 | N/A* |
| SINGLE METAL PIPES OR CONDUIT | 1 | CAJ1079 | CAJ 1226, CAJ 1382 | CAJ 1058 | CAJ 1064, CAJ 1302 | SINGLE METAL PIPES OR CONDUIT | 1 | CAJ 1079 | CAJ 1226, WJ 1021 | CAJ 1058 | CAJ 1064, CAJ 1302 |
| | 2 | CAJ1079 | CAJ 1226, CAJ 1382 | CAJ 1058 | CAJ 1064, CAJ 1302 | | 2 | CAJ 1079 | CAJ 1226, WJ 1021 | CAJ 1058 | CAJ 1064, CAJ 1302 |
| | 3 | CAJ1079 | FA 1017, CAJ 1226, CAJ 1382 | CAJ 1058 | CAJ 1064 | | 3 | CAJ 1079 | CAJ 1226, WJ 1041, WJ 1042 | CAJ 1058 | CAJ 1064 |
| | 4 | CAJ1079 | CBJ 1037, CBJ 1034 | CAJ 1044 | CAJ 1064 | | 4 | WJ 1070, CAJ 1079 | CBJ 1034, CBJ 1037, WJ 1041, WJ 1042 | CAJ 1044 | CAJ 1064 |
| SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, ENT) | 1 | CAJ 2125 | FA 2053, CAJ 2109, CAJ 2098, CAJ 2141, CAJ 2167, CBJ 2021 | CAJ 2189, CAJ 2117, CAJ 2027 | CAJ 2075, CAJ 2116, CAJ 2229 | SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, ENT) | 1 | CAJ 2125 | CAJ 2109, CAJ 2098 | CAJ 2189, CAJ 2117, CAJ 2027 | CAJ 2075, CAJ 2116, CAJ 2229 |
| | 2 | CAJ 2125 | FA 2053, CAJ 2109, CAJ 2098, CAJ 2141, CAJ 2167, CBJ-2021 | CAJ 2189, CAJ 2117 | CAJ 2075, CAJ 2116, CAJ 2229, FA 2024 | | 2 | CAJ 2125 | CAJ 2109, CAJ 2098 | CAJ 2189, CAJ 2117, CAJ 2027 | CAJ 2075, CAJ 2116, CAJ 2229 |
| | 3 | CAJ 2125 | FA 2054, CAJ 2109, CAJ 2098 | CAJ 2005, CAJ 2117 | CAJ 2075 | | 3 | CAJ 2125 | CAJ 2109, CAJ 2098 | CAJ 2005, CAJ 2117, CAJ 2027 | CAJ 2075 |
| | 4 | N/A* | N/A* | N/A* | N/A* | | 4 | WJ 2061 | WJ 2057 | N/A* | N/A* |
| SINGLE OR BUNDLED CABLES | 1 | CAJ 3154 | FA 3007, CAJ 3095, CAJ 3096 | CAJ 3021 | CAJ 3141 | SINGLE OR BUNDLED CABLES | 1 | CAJ 3154, WJ 3043 | WJ 3036, CAJ 3095, CAJ 3096 | CAJ 3021 | CAJ 3141 |
| | 2 | CAJ 3154 | FA 3007, CAJ 3095, CAJ 3096 | CAJ 3021 | CAJ 3141 | | 2 | CAJ 3154, WJ 3043 | WJ 3036, CAJ 3095, CAJ 3096 | CAJ 3021 | CAJ 3141 |
| | 3 | CAJ 3154 | CAJ 3095, FA 3007 | CAJ 3030 | CAJ 3141 | | 3 | CAJ 3154 | CAJ 3095, CAJ 3096 | CAJ 3030 | CAJ 3141 |
| | 4 | N/A* | N/A* | N/A* | N/A* | | 4 | WJ 3091 | WJ 3050 | N/A* | N/A* |
| CABLE TRAY | 1 | CAJ 4029 | CAJ 4034, CAJ 4054 | CAJ 4003 | N/A* | CABLE TRAY | 1 | WJ 4021, WJ 4022 | WJ 4016, CAJ 4034, CAJ 4054 | CAJ 4003 | WJ 4012 |
| | 2 | CAJ 4029 | CAJ 4034, CAJ 4054 | CAJ 4003 | N/A* | | 2 | WJ 4021, WJ 4022 | WJ 4016, CAJ 4034, CAJ 4054 | CAJ 4003 | WJ 4012 |
| | 3 | CAJ 4029 | CAJ 4034, CAJ 4035 | CAJ 4003 | N/A* | | 3 | CAJ 4029 | CAJ 4034, CAJ 4035 | CAJ 4003 | N/A* |
| | 4 | N/A* | N/A* | N/A* | N/A* | | 4 | CAJ 4029 | WJ 8007 | N/A* | N/A* |

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| | | | | | | | | | | | |
|---|---|----------|--|------------------------------|--------------------|---|---|----------|--------------------------------------|------------------------------|--------------------|
| SINGLE INSULATED PIPES | 1 | CAJ 5087 | FA 5015, FA 5016, CAJ 5090, CAJ 5091, CAJ 5098 | CAJ 5080, CAJ 5024, CAJ 5017 | CAJ 5111, CAJ 5121 | SINGLE INSULATED PIPES | 1 | WJ 5046 | CAJ 5090, CAJ 5091, CAJ 5061 | CAJ 5080, CAJ 5024, CAJ 5017 | CAJ 5111, CAJ 5121 |
| | 2 | CAJ 5087 | FA 5015, FA 5016, CAJ 5090, CAJ 5091, CAJ 5098 | CAJ 5080, CAJ 5024, CAJ 5017 | CAJ 5111, CAJ 5121 | | 2 | WJ 5046 | CAJ 5090, CAJ 5091, CAJ 5061 | CAJ 5080, CAJ 5024, CAJ 5017 | CAJ 5111, CAJ 5121 |
| | 3 | CAJ 5021 | FA5016, CAJ 5090 | CAJ 5024, CAJ 5017 | N/A* | | 3 | WJ 5046 | CAJ 5090, CAJ 5061 | CAJ 5024, CAJ 5017 | N/A* |
| | 4 | N/A* | CBJ 5006 | N/A* | N/A* | | 4 | WJ 5072 | WJ 5028, CBJ 5006 | N/A* | N/A* |
| ELECTRICAL BUSWAY | 1 | CAJ 6018 | CAJ 6006, CAJ 6017 | CAJ 6001, CAJ 6002 | CAJ 6007 | ELECTRICAL BUSWAY | 1 | CAJ 6018 | CAJ 6006, CAJ 6017 | CAJ 6001, CAJ 6002 | CAJ 6007 |
| | 2 | CAJ 6018 | CAJ 6006, CAJ 6017 | CAJ 6001, CAJ 6002 | CAJ 6007 | | 2 | CAJ 6018 | CAJ 6006, CAJ 6017 | CAJ 6001, CAJ 6002 | CAJ 6007 |
| | 3 | CAJ 6018 | CAJ 6006, CAJ 6017 | CAJ 6001, CAJ 6002 | CAJ 6007 | | 3 | CAJ 6018 | CAJ 6006, CAJ 6017 | CAJ 6001, CAJ 6002 | CAJ 6007 |
| NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS | 1 | CAJ 7027 | CAJ 7046 CAJ 7051 | CAJ 7003, CAJ 7021 | CAJ 7005, CAJ 7044 | NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS | 1 | | CAJ 7046, CAJ 7051, WJ 7021, WJ 7022 | CAJ 7003, CAJ 7021 | CAJ 7005, CAJ 7044 |
| | 2 | CAJ 7027 | CAJ 7046 CAJ 7051 | CAJ 7003, CAJ 7021 | CAJ 7005, CAJ 7044 | | 2 | | CAJ 7046, CAJ 7051, WJ 7021, WJ 7022 | CAJ 7003, CAJ 7021 | CAJ 7005, CAJ 7044 |
| | 3 | | CAJ 7046 CAJ 7051 | CAJ 7003, CAJ 7021 | CAJ 7005 | | 3 | | CAJ 7046, CAJ 7051 | CAJ 7003, CAJ 7021 | CAJ 7005 |
| MIXED PENETRANTS | 1 | CAJ 8113 | CAJ 8041, CAJ 8056, CAJ 8096 | CAJ 8001, CAJ 8013 | CAJ 8057 | MIXED PENETRANTS | 1 | CAJ 8113 | CAJ 8041, CAJ 8096, WJ 8007 | CAJ 8001, CAJ 8013 | CAJ 8057 |
| | 2 | CAJ 8113 | CAJ 8041, CAJ 8056, CAJ 8096 | CAJ 8001, CAJ 8013 | CAJ 8057 | | 2 | CAJ 8113 | CAJ 8041, CAJ 8096, WJ 8007 | CAJ 8001, CAJ 8013 | CAJ 8057 |
| | 3 | CAJ 8093 | CAJ 8041, CAJ 8056 | CAJ 8001, CAJ 8013 | N/A* | | 3 | CAJ 8093 | CAJ 8041, CAJ 8056, WJ 8007 | CAJ 8001, CAJ 8013 | N/A* |
| | 4 | CAJ 8093 | CBJ 8010 | N/A* | N/A* | | 4 | CAJ 8093 | CBJ 8010, WJ 8007 | N/A* | N/A* |

| SCHEDULES OF UL-2079 (DYNAMIC) JOINT FIRESTOP SYSTEMS | | | | | | | | | |
|--|----------|--|---|--|-----------|-------------------------|---------------------------------|--|----------|
| UL-CLASSIFIED SYSTEM | | | | | | | | | |
| JOINT WIDTH LESS THAN OR EQUAL TO 2" | | | | | | | | | |
| JOINT WIDTH GREATER THAN 2", LESS THAN OR EQUAL TO 6" | | | | | | | | | |
| JOINT TYPE | F-RATING | STI | HILTI | 3M | TREMCO | HILTI | 3M | STI | TREMCO |
| CONCRETE FLOOR-TO-FLOOR | 1 | FFD 1025 FFD 0015 | - | FF-D-0002 | FF-D-0009 | FF-D-1012, FF-D-1013 | FF-D-1002, FF-D-1003, FF-D-1004 | FFD 1025 | |
| | 2 | FFD 1025 FFD 0015 | - | FF-D-0002 | FF-D-0009 | FF-D-1012, FF-D-1013 | FF-D-1002, FF-D-1003, FF-D-1004 | FFD 1025 | |
| | 3 | FFD 1025 FFD 0015 | - | N/A** | FF-D-0010 | FF-D-1011, FF-D-1026 | N/A** | FFD 1025 | |
| EDGE OF CONCRETE FLOOR SLAB TO-WALL (USE ONLY CWS OR CWD SYSTEMS PER UL) | 1 | CWS 1003 CWS 2050 CWS 2051 CWS 2052 | N/A*** | N/A*** | N/A*** | N/A*** | N/A*** | CWS 1003 CWS 2050 CWS 2051 CWS 2052 | N/A*** |
| | 2 | CWS 1003 CWS 2050 CWS 2051 CWS 2052 | N/A*** | N/A*** | N/A*** | N/A*** | N/A*** | CWS 1003 CWS 2050 CWS 2051 CWS 2052 | N/A*** |
| | 3 | CWS 2050 CWS 2051 CWS 2052 | N/A*** | N/A*** | N/A*** | N/A*** | N/A*** | CWS 2050 CWS 2051 CWS 2052 | N/A*** |
| CONCRETE OR BLOCK WALL TO FLAT CONCRETE SLAB FLOOR (TOP-OF-WALL) | 1 | HWD 1034 | HW-D-0097 | HW-D-0023, HW-D-0029 | HW-D-0017 | HW-D-1008, HW-D-1009 | HW-D-1003 | HWD 1034 | HWD 1011 |
| | 2 | HWD 1034 | HW-D-0097 | HW-D-0023, HW-D-0029 | HW-D-0017 | HW-D-1008, HW-D-1009 | HW-D-1003 | HWD 1034 | HWD 1011 |
| | 3 | HWD 1034 | - | - | N/A** | HW-D-1008 | HW-D-1002, HW-D-1007 | HWD 1034 | HWD 1011 |
| CONCRETE OR BLOCK WALL TO CONCRETE OVER FLUTED METAL DECK (TOP-OF-WALL) | 1 | HWD 0086 HWD 0139 | HW-D-0080, HW-D-0081, HW-D-0098, HW-D 0181 | HW-D-0022, HW-D-0030, HW-D-0040 HW-D-0013 | HW-D-0092 | N/A** | | | |
| | 2 | HWD 0086 HWD 0139 | HW-D-0080, HW-D-0081, HW-D-0098, HW-D 0181 | HW-D-0022, HW-D-0030, HW-D-0040 HW-D-0013 | HW-D-0092 | | | | |
| | 3 | HWD 0086 HWD 0139 | N/A** | N/A** | N/A** | | | | |
| CONCRETE WALL-TO-WALL | 1 | WWD 0018 | WW-D-0017 | - | WW-D-0009 | WW-D-1011, WW-D-1012 | WW-D-1003, WW-D-1004, WW-D-1010 | WWD 1007 | N/A** |
| | 2 | WWD 0018 | WW-D-0017 | - | WW-D-0009 | WW-D-1011, WW-D-1012 | WW-D-1003, WW-D-1004, WW-D-1010 | WWD 1007 | N/A** |
| | 3 | WWD 0018 | - | - | WW-D-0010 | WW-D-1011 | WW-D-1003, WW-D-1010 | WWD 1007 | N/A** |

** CONTACT MANUFACTURER FOR CURRENT UL-CLASSIFIED SYSTEM OR ENGINEER JUDGEMENT DRAWING

*** UL REQUIRES CWS OR CWD SYSTEMS FOR PERIMETER FIRE CONTAINMENT SYSTEMS. USE SYSTEMS LISTED IN THE XHDG SECTION OF THE UL FIRE RESISTANCE DIRECTORY VOLUME II ONLY.

Notes:

1. CLASSIFIED SYSTEMS FOR 2"-6" WIDE JOINTS MAY BE USED FOR JOINTS 2" WIDE AND LESS.
2. CONFIRM THAT MOVEMENT CAPABILITIES OF THE SELECTED UL SYSTEM MEETS OR EXCEEDS THE SPECIFIED MOVEMENT RANGE OF THE PARTICULAR JOINT.
3. SYSTEMS MARKED WITH ASTERIK (*) ARE SUITABLE FOR TOP OF WALL JOINTS WHERE THE FLUTED METAL DECK HAS SPRAY ON MONOKOTE MK-6/HY FIREPROOFING.

END OF SECTION 07 84 13

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nonstaining silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Mildew-resistant joint sealants.
 - 4. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.4 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. Provide sealants by one of the following:
 - a. General Electric Company
 - b. Pecora Corp.
 - c. Dow Corning

2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Provide products by Sonneborn or prior approved equal.

2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Provide products by one of the following:
 - a. General Electric Company
 - b. Pecora Corp.
 - c. Dow Corning
- C. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Provide products by one of the following:
 - a. Bostik
 - b. Pecora Corp.
 - c. Sonneborn
 - d. Sika
 - e. Tremco Incorporated

2.5 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular 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.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.6 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.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind 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.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. 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 and 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 allow optimum sealant movement capability.
- E. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.3 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 - 1. As provided in Section 321373 – “Concrete Paving Joint Sealants”

- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints in unit masonry.
 - b. Joints associated with exterior walls, roofing and sheet metal.
 - c. Door and window frame joints.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, non-staining, S, NS, 50, NT or urethane, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- C. Joint-Sealant Application: Interior joints in vertical and horizontal tile surfaces.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, P, 25, T, NT or urethane, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
 - 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Acrylic latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control, corner and expansion joints.
 - c. Other joints as indicated on Drawings and associated with coffee brewing areas.
 - 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- G. Joint-Sealant Application: Concealed mastics.
 - 1. Joint Locations:
 - a. Aluminum thresholds.

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- b. Sill plates.
- 2. Joint Sealant: Butyl-rubber based.
- 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

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. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
3. Division 08 Section "Flush Wood Doors".
4. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
5. Division 08 Section "Door Hardware".
6. Division 08 Section "Access Control Hardware".
7. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.

14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Include the following:
 1. Elevations of each door design.
 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of anchorages, joints, field splices, and connections.
 6. Details of accessories.
 7. Details of moldings, removable stops, and glazing.
 8. Details of conduit and preparations for power, signal, and control systems.
- D. Samples for Verification:
 1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.
 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

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- E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:
 - 1. CECO Door Products (C).

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.
- B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Design: Flush panel.
 - 2. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
 - 3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 - 4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 - 5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Design: Flush panel.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - 2. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
 - 3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
 - 4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 - 5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Manufacturers Basis of Design:
 - 1. CECO Door Products (C) Honeycomb Core - Regent Series.
 - 2. CECO Door Products (C) Energy Efficient - Trio-E Series.

2.4 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
 - 1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 - 2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 - 3. Manufacturers Basis of Design:
 - a. CECO Door Products (C) – SU SR Series.
- C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
 - 1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 - 2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 - 3. Manufacturers Basis of Design:
 - a. CECO Door Products (C) - BU DU Series.
 - b. CECO Door Products (C) - SU Series.
- D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
- E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
 - 3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LOUVERS

- A. Metal Louvers: Unless otherwise indicated provide louvers to meet the following requirements.
 - 1. Blade Type: Vision proof inverted V or inverted Y.
 - 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.
- B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.

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1. Manufacturers: Subject to compliance with requirements, provide louvers to meet rating indicated.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.7 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
- B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.
- C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.
- D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.8 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.9 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Hollow Metal Doors:
 1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
 2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
 3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
- D. Hollow Metal Frames:
 1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

- a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
 3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
 5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
 6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
 7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
 8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 9. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
 10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
 11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.
- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.10 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

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. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
 - 1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 - 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

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1. Non-Fire-Rated Standard Steel Doors:
 - a. Jams and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

- D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 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.

END OF SECTION 081113

SECTION 08 14 16 – FLUSH WOOD DOORS

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. Section Includes:

1. Solid core doors with wood veneer faces.
2. Factory finishing wood doors.
3. Factory fitting wood doors to frames and factory machining for hardware.
4. Light frames and glazing installed in wood doors.

B. Related Sections:

1. Division 08 Section "Hollow Metal Doors and Frames" for wood doors in steel frames.
2. Division 08 Section "Glazing" for glass view panels in wood doors.
3. Division 08 Section "Door Hardware" for door hardware for flush wood doors and wood frames.
4. Division 08 Section "Access Control Hardware" for electromechanical hardware for flush wood doors and wood frames.

C. Standards and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A208.1 – Wood Particleboard.
2. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
3. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
4. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
5. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
6. Window and Door Manufacturers Association - WDMA I.S.1-A Architectural Wood Flush Doors.

1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.1-A or AWS classifications. Include factory finishing specifications.

- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the wood door supplier in order to prepare the doors and frames to receive the finish hardware items.

- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire protection ratings for fire rated doors.

D. Samples for Initial Selection: For factory finished doors.

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
2. Corner sections of doors, 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - a. Provide samples for each species of veneer and solid lumber required.
 - b. Finish veneer faced door samples with same materials proposed for factory finished doors.
3. Frames for light openings, 6 inches long, for each material, type, and finish required.

E. Warranty: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors".
- C. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for receiving, handling, and installing flush wood doors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package pre-finished doors individually in plastic bags or cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in wood face veneers exceeding 0.01 inch in a 3-inch span.

- c. Telegraphing of core construction and delaminating of face in decorative laminate-faced doors.
2. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid Core Interior Doors: Life of installation according to manufacturer's written warranty.

PART 2 - PRODUCTS

2.1 DOOR CONSTRUCTION – GENERAL

- A. WDMA I.S.1-A Performance Grade: Extra Heavy Duty; Aesthetic Grade: Premium.

2.2 CORE CONSTRUCTION

- A. Particleboard Core Doors:

1. Particleboard: Wood fiber based materials complying with ANSI A208.1 Particleboard standard. Grade LD-2.
2. Adhesive: Fully bonded construction using Polyurethane (PUR) glue.
3. Blocking: When through-bolted hardware is not used, provide wood blocking in particleboard core doors as follows:
 - a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
 - b. 5-inch (125-mm) mid-rail blocking, in doors indicated to have exit devices.
 - 1) Optional Cores for Blocking: Provide doors with either glued-wood-stave or structural-composite-lumber core instead of particleboard core for doors indicated to receive closers and exit devices.

2.3 VENEERED DOORS FOR TRANSPARENT FINISH

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eggers Industries: Premium
2. Graham: GPD
3. Marshfield: Signature
4. Oshkosh Door Company.; 920-233-6161; www.oshkoskdoor.com
5. Or approved Equal.

- B. Interior Solid Core Doors:

1. Grade: Premium
2. Faces: Veneer grades as noted below; veneer minimum 1/50-inch (0.5mm) thickness at moisture content of 12% or less.
 - a. Rotary Cut White Birch, A grade faces.
3. Match between Veneer Leaves: Book match.

4. Assembly of Veneer Leaves on Door Faces:
 - a. Running Match.
5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
6. Transom Match: Continuous match.
7. Vertical Edges: Matching same species as faces. Wood or composite material, one piece, laminated, or veneered. Minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors.
8. Horizontal Edges: Solid wood or structural composite material meeting the minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors
9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit sanded before applying face veneers.
10. At doors over 40% of the face cut-out for lights and or louvers, furnish engineered composite lumber core.

2.4 LIGHT FRAMES AND GLAZING

- A. Wood Beads for Light Openings in Wood Doors up to and including 20-minute rating:
 1. Wood Species: Same species as door faces.
 2. Profile: Manufacturer's standard lipped profile. At wood core doors with 20-minute fire protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Metal Frames for Light Openings in Fire Rated Doors over 20-minute rating: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated.
- C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with the flush wood door manufacturer's written instructions.

2.5 FABRICATION

- A. Factory fit doors to suit frame opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 1. Comply with requirements in NFPA 80 for fire rated doors.
- B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.
- C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
- D. Openings: Cut and trim openings through doors in factory.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Comply with applicable requirements in Division 08 Section "Glazing."
 3. Louvers: Factory install louvers in prepared openings.

- E. Electrical Raceways: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 08 "Door Hardware". Wire nut connections are not acceptable.

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Transparent Finish: Provide a clear protective coating over the wood veneer allowing the natural color and grain of the selected wood species to provide the appearance specified. Stain is applied to the wood surface underneath the transparent finish to add color and design flexibility.
 - 1. Grade: Premium.
 - 2. Finish: Meet or exceed WDMA I.S. 1A TR6 Catalyzed Polyurethane finish performance requirements.
 - 3. Staining: As selected by Architect from manufacturer's full range.
 - 4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 - 1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.
- C. Factory Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Re-hang or replace doors that do not swing or operate freely.

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- B. Finished Doors: Replace doors that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION – 08 14 16

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SECTION 083600 – OVERHEAD SECTIONAL DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Overhead doors.
- B. Bi-fold doors.
- C. REDD™ (Renlita Electric Direct Drive) Motor System

1.2 RELATED SECTIONS

- A. Section 03300 - Cast-In-Place Concrete: Prepared opening in concrete. Execution requirements for placement of anchors in concrete wall construction.
- B. Section 04810 - Unit Masonry Assemblies: Prepared opening in masonry. Execution requirements for placement of anchors in masonry wall construction.
- C. Section 05500 - Metal Fabrications: Steel frame and supports.
- D. Section 06114 - Wood Blocking and Curbing: Rough wood framing and blocking for door opening.
- E. Section 07900 - Joint Sealers: Perimeter sealant and backup materials.
- F. Section 08710 - Door Hardware: Cylinder locks.
- G. Section 09900 - Paints and Coatings:
- H. Section 16050 - Basic Electrical Materials and Methods: Installation and requirements for electrical connections.
- I. Section 16150 - Wiring Connections: Electrical service to door operator.
- J. National Electric Manufacturers Association (NEMA): NEMA ICS 4 - Industrial Control and Systems: Enclosures.

1.3 REFERENCES

- A. ASTM C1048 - Glass Tempered
- B. AA-6063-T6 - Standards for Aluminum Alloy and Temper.
- C. ASTM A513, Type 1 – Steel Tubes.
- D. ASTM A1008 – Sheet Steel for Covers.
- E. ASTM A36 – Steel Bars.
- F. ASTM A36 – Sheet Steel for Tracks/Channels.

1.4 PERFORMANCE REQUIREMENTS

- A. Wind Loads: Design and size components to withstand loads caused by pressure and suction of wind acting normal to plane of wall as calculated in accordance with applicable code in both open and closed position.
 - 1. Design pressure: See structural drawings.

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2. Maximum deflection of 1/300 of opening width.
- 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.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- 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. Installation manuals.
 4. Owners Manual with service information
- C. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, accessories and anchors, jamb details, connection details, anchorage spacing, hardware locations, and installation details.
- D. Selection Samples: For each finish product specified, two complete sets of color charts representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 3 inches (150 mm) square, representing actual product, color, and patterns.
- F. Operation and Maintenance Data.
- G. Submit written agreement in manufacturer's standard form signed by manufacturer and installer agreeing to repair or replace defective doors that are warped, twisted, bowed or damaged as a result of defective product.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience and/or be a factory trained and authorized installation company.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.
- D. REDD™ Motor System shall be warranted against manufacturing defects for a period of 2 years.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer, material, and location of installation.
- B. Storage: Store materials in a dry area indoor and protected from damage and in accordance with manufacturer's instructions.
- C. Handling: Handle and lift all items carefully during installation to prevent damage and protect finishes.

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1.8 PROJECT CONDITIONS

- A. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
- B. Environmental Conditions: Prior to and during installation, environmental conditions shall be in accordance with door manufacturers latest published recommendations for temperature, rain, wind, humidity, ventilation, and illumination.
- C. Opening shall be free and clear of debris, stored materials, scaffolding, and temporary walls as necessary for installers to perform the installation.

1.9 WARRANTY

- A. Manufacturer warrants to the original purchaser within two years from date of installation, if a product sold under this warranty proves to be defective in material or workmanship through normal use and service according to maintenance and operations instructions, as verified by inspection by persons authorized by Renlita Over-head Doors, Renlita Overhead Doors will replace or repair (at Renlita Overhead Doors option) the defective product.
- B. Manufacturer warrants the steel frame against rust, in painted non-damaged condition for a period of two years from original purchase. This warranty does not apply to scratched, dented, damaged or corroded areas of the frame.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. BASIS OF DESIGN - Renlita Doors North America, LLC; www.renlitausa.com
2430 Albert Broadfoot St.
Bonham, TX 75418
- B. Or approved equal

2.2 OVERHEAD DOORS

- A. Two Leaf Hinged Stacking Overhead Doors: Two horizontal panels hinged together, weather lapped at horizontal joint; rising vertically on roller and track system fixed to building structure to stack in a folded position under lintel.
- B. Approved Product (BASIS OF DESIGN): A-750 Nu-Fold.
- C. Framework: Welded construction fabricated from extruded hollow section aluminum members with minimum wall thickness of 0.125 inch (3.1 mm). Beams shall be designed for maximum dead load deflection of 1/300th part of the span.
- D. Operating Channels fabricated from carbon steel hot rolled sheet to comply with ASTM A-36. Final finish on track in accordance with Part 2.4.
- E. Counter Balancing: Counterweight system with enclosed counterweights suspended by 7/19 flexible multi-strand steel cables with minimum safety factor of 6:1. Cable shall be guided in steel sheaves with a minimum sheave to cable diameter ratio of 19:1. Sheaves shall be capable of carrying design loads.
- F. Load is contained in the jambs and does not require a load bearing header or any additional lateral supports

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- G. Construct steel door sections from carbon steel hot rolled tube complying with ASTM A-513 Type 1 and ASTM A-36.
- H. Counterweight Covers: Counterweights shall be protected and covered with a re-movable pressed sheet (aluminum or steel).
- I. Size:
 - 1. As indicated on Drawings.
- J. Locking:
 - 1. Internal slide locks, unless otherwise specified.

2.3 GLAZING AND CLADDING

- A. Glazing: Glazed in accordance with AS1288.
 - 1. Glass: 1 inch (25 mm) dual pane insulated glass.
- B. Panels:
 - 1. Panels: Metal.
- C. Glazing to be factory cut and attached. All pieces to be test fit in factory prior to shipping 2.4. FINISHES
- D. Finish, Aluminum: All surfaces except working machine parts shall receive the following factory applied finish:
 - 1. Powder coating.
 - 2. Abrasive clean to SSP-SP6
- E. Finish, Aluminum glazing capture: Provide the following factory applied finish:
 - 1. Clear anodized aluminum.
 - 2. Powder coating to comply with AAMA 2604 Standards
- F. Finish, Color:
 - 1. As selected from manufacturer's full range of available colors.
 - 2. Manufacturer warranty on finish to be 2 years.

2.4 MOTORS

- A. Model: REDD™ (Renlita Electric Direct Drive), 1HP AC motor with 39:1 gear ratio gearbox direct mounted to 1" door drive shaft. Motor is provided with control panel (mounted separately) and is controlled by a touch screen control station, photo eyes, and hardware necessary for installation of motor and control panel.
 - 1. Primary Speed Reduction: Worm gear-in-oil-bath reducer. Gear ratio is 39:1 with shaft speed of 34 RPM
 - 2. Motor Travel: Motor up and down travel is set digitally in the control panel and door position is established by integrated shaft position encoder.
 - 3. Control Station: Touch screen control station provided as standard and is capable of being mounted into single gang electrical box (not provided by Renlita). Minimum dimensions of the electrical box are 3"x2"x2 1/2" and the box shall be square corner welded construction.
 - 4. Primary Entrapment Device: NEMA 4 Monitored Photo Sensors mounted maximum of 6 inches above the finished floor at each side of the door opening interior.
 - 5. Secondary Entrapment Device: REDD ALERT™ obstruction sensing technology. Door controls shall monitor the door operation for obstruction during the close cycle. If amperage increases above set limit, the motor shall stop and reverse direction. The sensitivity is set by a qualified installer during initial commissioning and shall be checked and adjusted annually.

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- B. Temperature Rating: -15°F to 125°F
 1. 100% duty cycle. Unlimited number of operations per hour.

- C. Construction:
 1. Frame: 18.52" x 4.31" x 8.425"
 2. Frame Color: RAL 9005 Black - confirm with Architect
 3. Gearbox Oil Type: CLP VG680 Mineral Oil
 4. Bearings: Sealed Bearings - pre lubricated from factory
 5. Mounting: M4 - Vertical Orientation or M3 Horizontal Orientation.
 6. Power Requirements: 110 volt AC, Single Phase, 6 amps.

- D. Accessories
 1. Universal Radio Receiver: Manufactured by Liftmaster™ model 850 LM.
 - a. Capable of 310 Mhz, 315 Mhz, or 390 Mhz radio transmitters with Security + 2.0 Remotes
 - b. Direct wires into Renlita REDD™ control panel. Power and controls are administered by REDD™ Control panel.

- E. Quality Control
 1. Factory Tests:
 - a. Cycle each REDD™ motor head and gearbox before packaging to insure proper operation.
 - b. Bench test each touch screen control panel prior to packaging for proper operation and configuration.

PART 3 EXECUTION

- A. Notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions. Commencement of installation constitutes acceptance of conditions.

- B. Complete installation and wiring in accordance with Renlita installation manual for REDD motor system. Ensure proper orientation for motor system in accordance with written instructions.

3.1. EXAMINATION

- A. Do not begin installation until openings have been properly prepared.

- B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

- C. Verify electric power is available and of correct characteristics.

- D. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2. 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.

3.3. INSTALLATION

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- A. Inserts and Anchorages: Furnish inserts and anchoring devices suitable for the installation of the units and consistent with the manufacturer's installation requirements. Coordinate delivery with other work to avoid delay.
- B. Install overhead doors, operating equipment, hardware, seals, stops, anchors, inserts, supports and track in accordance with approved shop drawings and the manufacturer's printed instructions.
- C. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
- D. Anchor assembly to wall construction and building framing without distortion or stress.
- E. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- F. Fit and align door assembly including hardware.
- G. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.
- H. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction. Test for proper operation and adjust until satisfactory results are obtained. Demonstrate operation to owner's personnel.

3.4. CLEANING AND ADJUSTING

- A. Lubricate, test and adjust door assembly to smooth operation free from warp twist or distortion and in full contact with weather-stripping.
- B. Clean doors, frames and glass.
- C. Remove temporary labels and visible markings.

3.5. PROTECTION

- A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.
- B. Protect installed products until completion of project.
- C. Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion.

3.6. MAINTENANCE

- A. Post Installation Maintenance:
 - 1. Contractor and installer shall provide Owner with complete company name, address phone number, fax number and assigned contact for emergency re-pairs and scheduled maintenance for the installed door(s).
- B. Training/Instruction for Owner for Operation and System Maintenance:
 - Manufacturer shall instruct Owner's representative in regular tenant provided maintenance and operation of installed doors.

END OF SECTION 086300

SECTION 084113 – ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

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 covers Kawneer Architectural Aluminum Storefront Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of storefront units.
- B. Types of Kawneer Aluminum Storefront Systems include:
 - 1. Trifab® Versaglaze® 601T Framing System
 - a. 2" x 6" (50.8 mm x 152.4 mm) nominal dimension
 - b. Thermal
 - c. Center Plane
 - d. Screw Spline Fabrication
- C. Related Sections:
 - 1. 072700: Air Barriers
 - 2. 079200: Joint Sealants
 - 3. 084113: Aluminum-Framed Entrances and Storefronts
 - 4. 084413: Glazed Aluminum Curtain Walls
 - 5. 088000: Glazing
 - 6. 107113: Exterior Sun Control Devices
 - 7. 122600: Interior Daylighting Devices

1.3 DEFINITIONS

- A. For fenestration industry standard terminology and definitions, refer to the Fenestration & Glazing Industry Alliance (FGIA) Glossary (AAMA AG-13).

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance:
 - 1. Product to comply with the specified performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction, as determined by testing of aluminum storefront systems representing those indicated for this project.
 - 2. Aluminum storefront systems shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 3. Failure includes any of these events:
 - a. Thermal stresses transferring to building structure
 - b. Glass breakage
 - c. Loosening or weakening of fasteners, attachments, and other components

- d. Failure of operating units
- B. Delegated Design:
- 1. Design aluminum storefront systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Wind Loads:
- 1. The storefront system shall include anchorage that is capable of withstanding the following wind load design pressures:
 - a. Inward: See structural drawings
 - b. Outward: See structural drawings
- D. Air Leakage:
- 1. The test specimen shall be tested in accordance with ASTM E 283.
 - 2. With interior seal, air leakage rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 6.2 psf (300 Pa).
 - 3. Without interior seal, air leakage rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 1.6 psf (75 Pa).
 - 4. CSA A440 Fixed Rating
- E. Water Resistance:
- 1. The test specimen shall be tested in accordance with ASTM E 331.
 - 2. There shall be no leakage at a minimum static air pressure differential of 10 psf (479 Pa) as defined in AAMA 501.
 - 3. CSA A440 B5 Rating
- F. Uniform Load:
- 1. A static air design load of 30 psf (1436 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330.
 - 2. A static air design load of 350T doors shall be 60.15 psf (2880 Pa) for single doors and 50.13 psf (2400 Pa) for pairs of doors and shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 for typical application or L/180 for Small-Missile and Large-Missile impact, of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
 - 3. There shall be no deflection in excess of L/175 of the span of any framing member.
 - 4. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
 - 5. CSA A440 C2 Rating
- G. Thermal Transmittance (U-factor):
- 1. Thermal transmittance test results are based upon 1" (25.4 mm) clear high-performance insulating glass [1/4" (e=0.035, #2), 1/2" warm edge spacer and argon fill gas, 1/4"].
 - 2. When tested to AAMA Specification 1503, the thermal transmittance (U-factor) shall not be more than listed here:
 - a. Trifab® Versaglaze® 601T Framing System, Center Plane (0.28 COG) .40 or project specific (____) Btu/hr/ft²/°F per AAMA 507 or (____) Btu/hr/ft²/°F per NFRC 100.
 - b. 350T Insulpour™ Thermal Entrance, Insulated Glass – 0.52 (low-e) or Project Specific (____) BTU/hr/ft²/°F per AAMA 507 or (____) BTU/hr/ft²/°F per AAMA 507 per NFRC 100.

- H. 350T Insulpour™ Thermal Entrance, Solar Heat-Gain Coefficient (SHGC) : Glazed thermally broken aluminum door and frame shall have a Solar Heat Gain Coefficient (SHGC) of no greater than (.27) as determined according to NFRC 200.
- I. 350T Insulpour™ Thermal Entrance, Visible Transmittance (VT): Glazed thermally broken aluminum door and frame shall have a Visible Transmittance (VT) of no greater than (.50) as determined according to NFRC 200.
- J. Condensation Resistance Factor (CRF) or Condensation Index (CI):
 - 1. If using CRF: When tested to AAMA Specification 1503, the CRF shall not be less than listed here:
 - a. Trifab® Versaglaze® 601T Framing System, Center Plane 69_{frame} and 70_{glass} (low-e)
 - b. 350T: Insulated Glass – 49_{frame} and 68_{glass} (low-e).
 - 2. If using CI: When tested to CSA A-440, the CI shall not be less than listed here:
 - a. Trifab® Versaglaze® 601T Framing System, Front Plane 63_{frame} and 61_{glass} (low-e)
 - b. 350T: Insulated Glass – 37_{frame} and 66_{glass} (low-e).
- K. Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC):
 - 1. Sound transmission loss test results in accordance with AAMA 1801 are based upon 1" (25.4 mm) clear double laminated insulating glass with PVB interlayer (1/8", 0.030", 1/8", 1/2" AS, 1/8", 0.030", 1/8").
 - 2. Ratings shall not be less than listed here:
 - a. Trifab® VersaGlaze® 601T Framing System, Center Plane laminated glass STC 37 and OITC 31
 - b. 350T: 37 STC and 32 OITC

1.5 SUBMITTALS

- A. Product Data:
 - 1. For each type of aluminum-framed storefront system indicated, include:
 - a. Construction details
 - b. Material descriptions
 - c. Dimensions of individual components and profiles
 - d. Hardware
 - e. Finishes
 - f. Installation instructions
- B. Shop Drawings:
 - 1. Plans
 - 2. Elevations
 - 3. Sections
 - 4. Details
 - 5. Hardware
 - 6. Attachments to other work
 - 7. Operational clearances
 - 8. Installation details
- 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 aluminum-framed storefront system and required components.
- E. Product Test Reports:
1. Provide test reports for each type of aluminum-framed storefront used in the project.
 2. Test reports must be based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency.
 3. Test reports must indicate compliance with performance requirements.
- F. Fabrication Sample:
1. Provide a fabrication sample of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12" (304.8 mm) lengths of full-size components and showing details of the following:
 - a. Joinery, including concealed welds
 - b. Anchorage
 - c. Expansion provisions
 - d. Glazing
 - e. Flashing and drainage
- G. Entrance Door Hardware Schedule:
1. Schedule shall be prepared by or under the supervision of supplier.
 2. Schedule shall detail fabrication and assembly of entrance door hardware, including procedures and diagrams.
 3. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Installer must have successfully installed the same or similar units required for the project and other projects of similar size and scope.
- B. Manufacturer Qualifications:
1. Manufacturer must be capable of providing aluminum-framed storefront systems that meet or exceed performance the stated performance requirements.
 2. Manufacturer must document this performance by the inclusion of test reports and calculations.
- C. Source Limitations:
1. Obtain aluminum-framed storefront system through one source from a single manufacturer.
- D. Product Options:
1. Drawings indicate size, profiles, and dimensional requirements of aluminum-framed storefront system and are based on the specific system indicated. Refer to Division 01 Product Requirements Section. Do not modify size and dimensional requirements.
 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.
 2. Build mockups for the type(s) of storefront elevation(s) indicated, in location(s) shown on drawings.

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- F. Pre-installation Conference:
 - 1. Conduct conference at project site to comply with requirements in Division 01 Project Management and Coordination Section.
- G. Structural-Sealant Glazing must comply with ASTM C 1401, "Guide for Structural Sealant Glazing" for design and installation of structural-sealant-glazed systems.
- H. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.

1.7 PROJECT CONDITIONS

- A. Field Measurements:
 - 1. Verify actual dimensions of aluminum-framed storefront openings by field measurements before fabrication.
 - 2. Indicate measurements on shop drawings.

1.8 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

2.1 MANUFACTURERS

- A. Basis-of-Design Product:
 - 1. Kawneer Company, Inc.
 - 2. Trifab® Versaglaze® 601T Framing System
 - a. 2" x 6" (50.8 mm x 152.4 mm) nominal dimension
 - b. Thermal
 - c. Center Plane
 - d. Screw Spline Fabrication
 - e. The door stile and rail face dimensions of the 350T Insulpour™ Thermal Entrance will be as follows:
 - 1) Vertical Stile: 3-1/2" (88.9 mm)
 - 2) Top Rail: 3-1/2" (88.9 mm)
 - 3) Standard Bottom Rail: 6-1/2" (165.1 mm)
 - 3. Trifab™ 400 Framing System:
 - a. 1-3/4" x 4" (44.5 mm x 101.6 mm) nominal dimension
 - b. Non-Thermal
 - c. Center Plane
 - d. Screw Spline
 - e. Shear Block
 - f. Stick or Punched Opening Fabrication
- B. Substitutions:
 - 1. Refer to Division 01 Substitutions Section for procedures and submission requirements.
 - 2. Pre-Contract (Bidding Period) Substitutions:
 - a. Submit written requests ten (10) days prior to bid date.
 - 3. Post-Contract (Construction Period) Substitutions:

- a. Submit written request in order to avoid installation and construction delays.
 4. Product Literature and Drawings:
 - a. Submit product literature and drawings modified to suit specific project requirements and job conditions.
 5. Certificates:
 - a. Submit certificate(s) certifying that the substitute manufacturer (1) attests to adherence to specification requirements for storefront system performance criteria, and (2) has been engaged in the design, manufacture, and fabrication of aluminum storefronts for a period of not less than ten (10) years.
(*Company Name*)
 6. Test Reports:
 - a. Submit test reports verifying compliance with each test requirement required by the project.
 7. Samples:
 - a. Provide samples of typical product sections and finish samples in manufacturer's standard sizes.
- C. Substitution Acceptance:
1. Acceptance will be in written form, either as an addendum or modification.
 2. Acceptance will be documented by a formal change order signed by the owner and contractor.

2.2 MATERIALS

- A. Aluminum Extrusions:
1. Alloy and temper recommended by aluminum 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
- B. Fasteners:
1. Aluminum, nonmagnetic stainless steel or other materials must be non-corrosive and compatible with aluminum members, trim hardware, anchors, and other components.
- C. Anchors, Clips, and Accessories:
1. Anchors, clips, and accessories shall provide sufficient strength to withstand the design pressure indicated.
- D. Reinforcing Members:
1. Reinforcing members must provide sufficient strength to withstand the design pressure indicated.
- E. Sealant:
1. For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
 2. Slide-In-Type Weather Stripping: Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701/702.
- F. Weather Seals: Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.
- G. Thermal Barrier: Shall be IsoPour™ utilizing two continuous rows of polypropylene with a nominal 7/32" (5.5 mm) separation consisting of a two-part, chemically curing high density polyurethane which is mechanically and adhesively bonded to the aluminum at door rails and stiles.
- H. Tolerances:

1. References to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 STOREFRONT FRAMING SYSTEM

A. Thermal Barrier:

1. Trifab® Versaglaze® 601T:
 - a. Kawneer IsoLock™ Thermal Break with a nominal 1/4" (6.4 mm) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.

B. Brackets and Reinforcements:

1. Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.

C. Fasteners and Accessories:

1. Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories must be compatible with adjacent materials.
2. Where exposed, fasteners and accessories shall be stainless steel.

D. Perimeter Anchors:

1. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

E. Packing, Shipping, Handling, and Unloading:

1. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

F. 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.

2.4 GLAZING SYSTEMS

A. Glazing to meet requirements in Division 08 Glazing Section.

B. Glazing Gaskets:

1. Manufacturer's standard compression types
2. Replaceable, extruded EPDM rubber

C. Spacers and Setting Blocks:

1. Manufacturer's standard elastomeric type

D. Bond-Breaker Tape:

1. Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing Sealants for structural-sealant-glazed systems as recommended by manufacturer for joint type, and as follows:

1. Weatherseal sealant:

- a. ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O
- b. Single-component neutral-curing formulation that is compatible with the structural sealant and other system components with which it comes in contact
- c. Recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use
- d. Color: Matching structural sealant

2.5 HARDWARE

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum-framed entrance doors.
- B. Standard Hardware:
 1. Weather-stripping:
 - a. Meeting stiles on pairs of doors shall be equipped with two lines of weather-stripping utilizing wool pile with polymeric fin.
 - b. The door weathering on a single acting offset pivot or butt hung door and frame (single or pairs) shall be comprised of a thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing and a wool pile with polymeric fin.
 2. Sill Sweep Strips: EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners (Necessary to meet specified performance tests).
 3. Threshold: Extruded aluminum, thermally broken, with ribbed surface.
 4. Continuous Hinge: [Kawneer Standard]. (NOTE: Provide EL Hinge for access control)
 5. Push/Pull: [Kawneer CO-12] style.
 6. Exit Device: [Kawneer 1786].
 7. Closer: [LCN 5030].
 8. Security Lock/Dead Lock: Single Leaf [Adams Rite MS-1850-050]; Paired Leaves [Kawneer Controller].
 9. Latch Handle: [Kawneer 1786].
 10. Cylinder(s)/Thumbturn: [See Hardware Schedule].
 11. Strike: [Adams Rite Standard]
 12. Electric Strike/Strike Keeper: [Adams Rite 7130]

2.6 FABRICATION

- A. Fabricate framing member 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. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior
 4. Physical and thermal isolation of glazing from framing members
 5. Accommodations for thermal and mechanical movements of glazing and framing that maintain required glazing edge clearances
 6. Provisions for field replacement of glazing
 7. Fasteners, anchors, and connection devices that are concealed from view to the greatest extent possible
- B. Mechanically Glazed Framing Members:
 1. Fabricate for flush glazing without projecting stops.
- C. Structural-Sealant-Glazed Framing Members:

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1. Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

D. Storefront Framing:

1. Fabricate components for assembly using manufacturer's standard installation instructions.

E. After fabrication, clearly mark components to identify their locations in project according to shop drawings.

2.7 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 Permanodic® AA-M10C21A41 / AA-M45C22A41, AAMA 611, Architectural Class I Clear Anodic Coating (Color #14 Clear)

PART 3 EXECUTION

3.1 EXAMINATION

- A. With installer present, examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work:
 1. Verify rough opening dimensions.
 2. Verify levelness of sill plate.
 3. Verify operational clearances.
 4. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components for proper water management.
 5. Masonry Surfaces:
 - a. Masonry surfaces must be visibly dry and free of excess mortar, sand, and other construction debris.
 6. Wood Frame Walls:
 - a. Wood frame walls must be dry, clean, sound, well nailed, free of voids, and without offsets at joints.
 - b. Ensure that nail heads are driven flush with surfaces in opening and within 3" (76.2 mm) of opening.
 7. Metal Surfaces:
 - a. Metal surfaces must be dry and clean (free of grease, oil, dirt, rust, corrosion, and welding slag).
 - b. Ensure that metal surfaces are without sharp edges or offsets at joints.
- B. Proceed with installation only after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed storefront system, accessories, and other components.
- B. Install aluminum-framed storefront system so that components:
 1. Are level, plumb, square, and true to line
 2. Are without distortion and do not impede thermal movement
 3. Are anchored securely in place to structural support
 4. Are in proper relation to wall flashing and other adjacent construction
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weather-tight construction.

- D. Install aluminum-framed storefront system and components to drain condensation, water penetrating joints, and moisture migrating within aluminum-framed storefront system to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

A. Field Tests:

- 1. Architect shall select storefront units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured.
- 2. Conduct tests for air infiltration and water penetration with manufacturer's representative present.
- 3. Tests that do not meet the specified performance requirements and units that have deficiencies shall be corrected as part of the contract amount.
- 4. Testing shall be performed per AAMA 503 by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements.
- 5. Air Infiltration Tests:
 - a. Conduct tests in accordance with ASTM E 783.
 - b. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², whichever is greater.
- 6. Water Infiltration Tests:
 - a. Conduct tests in accordance with ASTM E 1105.
 - b. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 6.2 psf (300 Pa).

B. Manufacturer's Field Services:

- 1. Upon owner's written request, provide periodic site visit by manufacturer's field service representative.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjusting: Not applicable.

B. Protection:

- 1. Protect installed product's finish surfaces from damage during construction.

C. Cleaning:

- 1. Clean glass immediately after installation.
 - a. Comply with glass manufacturer's written recommendations for final cleaning and maintenance.
 - b. Remove non-permanent labels and clean surfaces.
- 2. Clean aluminum surfaces.
- 3. Avoid damaging protective coatings and finishes.
- 4. Remove excess sealants, glazing materials, dirt, and other substances.
- 5. Repair or replace damaged installed products.
- 6. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
- 7. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 084113

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

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

1.1 SUMMARY

- A. Section Includes: Kawneer Architectural Aluminum Curtain Wall Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of curtain wall framing

- 1. Types of Kawneer Aluminum Window Wall include:

- 1. 1600 Wall System®1 Curtain Wall:
 - Sight line: 2-1/2" (63.5 mm)
 - Outside-glazed pressure plate format
 - System depth: 7-1/2" (190.5 mm) for 1" (25.4 mm) insulating glazing and 1/4" (6.3 mm) monolithic glazing

- B. Related Sections:

- 1. 079200 "Joint Sealants"
- 2. 084113 "Aluminum-Framed Entrances and Storefronts"
- 3. 088100 "Architectural Glass"

1.2 DEFINITIONS

- A. Definitions: For fenestration industry standard terminology and definitions refer to Fenestration & Glazing Industry Alliance (FGIA) Glossary (AAMA AG-13)

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum window walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Glazed aluminum window walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Loosening or weakening of fasteners, attachments, and other components.
 - d. Failure of operating units.

- B. Delegated Design: Design glazed aluminum window walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - C. Wind loads: Reference Structural Drawings.
 - D. Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283. Air infiltration rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 6.2 psf (300 Pa).
 - E. Water Resistance, (static): The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a minimum static air pressure differential of 12 psf (575 Pa) as defined in AAMA 501.
 - F. Water Resistance, (cyclic): The test specimen shall be tested in accordance with ASTM E 547. There shall be no leakage at a minimum static air pressure differential of 12 psf (575 Pa) as defined in AAMA 501.
 - G. Water Resistance, (severe, wind driven rain): The test specimen shall be tested in accordance with AAMA 520 and ASTM E2268. The test specimen shall pass performance level 5, pressure limits 9 psf (431 Pa) – 27 psf (1293 Pa).
 - H. Uniform Load: A static air design load of 40 psf (1915 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member at design load. At structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
 - I. Energy Efficiency:
 - 1. Thermal Transmittance (U-factor): When tested to AAMA Specification 1503, AAMA Specification 507 or NFRC 100 the thermal transmittance (U-factor) shall not be more than:
 - a. 1" Low-e insulating glass with warm edge spacer: U-Factor not more than 0.38 BTU/hr/ft² /°F. per AAMA 1503 or NFRC 100 when using project specified glass.
 - J. Condensation Resistance Test (CRF): Provide aluminum window wall tested for thermal performance according to AAMA 1503, the condensation resistance factor (CRF) shall not be less than;
 - 1. 1" Low-e insulating glass with warm edge spacer.
 - a. CRF not less than 69_{frame} and 68_{glass}.
 - K. Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC): When tested in accordance with AAMA Specification 1801, the STC and OITC shall not be less than;
 - 1. 1" insulating glass made with exterior 1/4" glass, 1/2" spacer, and interior 1/4" laminated glass.
 - a. STC not less than 36; OITC not less than 31.
 - L. Environmental Product Declaration (EPD): Shall have a Type III Product-Specific EPD created from a Product Category Rule.
- 1.4 SUBMITTALS
- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - B. Shop Drawings: For glazed aluminum window walls. Include plans, elevations, sections, full-size details, and attachments to other work.

- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for glazed aluminum window walls, indicating compliance with performance requirements.
- F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed window wall systems, made from 12" (300 mm) lengths of full-size components and showing details of the following:
 - 1. Joinery
 - 2. Glazing

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who has had successful experience with installation of the same or similar systems required for the project and other projects of similar size and scope.
- B. Manufacturer Qualifications: A manufacturer capable of fabricating glazed aluminum window walls that meet or exceed performance requirements.
- C. Source Limitations: Obtain aluminum window wall system through one source from a single manufacturer.
- D. Product Options: 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.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups for type(s) of window wall elevation(s) indicated, in location(s) shown on Drawings.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination".

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for glazed aluminum window walls by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
 - 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product:

1. Kawneer Company Inc. or approved equal
2. 1600 Wall System®1 Curtain Wall:
3. Sight line: 2-1/2" (63.5 mm)
4. Outside-glazed pressure plate format
5. System depth: 6" (152.4 mm) or 7-1/2" (190.5 mm) for 1" (25.4 mm) insulating glazing and 1/4" (6.3 mm) monolithic glazing
6. Tested to AAMA 501, ASTM E 1886, E 1996, and TAS 201, 202, 203

B. Substitutions: Refer to Substitutions Section for procedures and submission requirements.

1. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.
2. Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid window wall installation and construction delays.
3. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
4. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for window wall system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum window walls for a period of not less than ten (10) years. (Company Name).
5. Test Reports: Submit test reports verifying compliance with each test requirement required by the project.
6. Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.

C. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Contractor.

2.2 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by glazed aluminum window wall manufacturer for strength, corrosion resistance, and application of required finish and each framing member shall have a wall thickness sufficient to meet the specified structural requirements and complying with ASTM B 221: 6063-T6 alloy and temper.
- B. Aluminum sheet alloy: Shall meet the requirements of ASTM B209.
- C. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window wall members, trim hardware, anchors, and other components.
- D. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- E. Pressure Plate: Pressure plate shall be aluminum. Pressure plate shall be fastened to the mullion with stainless steel screws.

- F. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- G. Sealant: For sealants required within fabricated window wall system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
- H. Thermal Barrier: Kawneer IsoLock™ Thermal Break with a 3/8" (9.5 mm) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum window wall sections.
 - 1. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.
- I. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of glazed window wall members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 WINDOW WALL FRAMING

- A. Framing Members: Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Glazing System: 4-sided captured
 - 2. Glazing Plane: Front
- B. Glass: 1" (25.4) insulating glass option.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.
- D. Framing Sealants: Shall be suitable for glazed aluminum window wall as recommended by sealant manufacturer.
- E. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.
- F. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- G. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- H. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle window wall material and components to avoid damage. Protect window wall material against damage from elements, construction activities, and other hazards before, during and after installation.

2.4 GLAZING

- A. Glazing: Comply with Division 08 Section "Glazing". Following glazing options are available.

1. System: Inside glazed or outside glazed system with 1" (25.4) double glazed insulating glass.
- B. Glazing Gaskets: Gaskets to meet the requirements of ASTM C864.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
- E. Glazing Sealants: As recommended by sealant manufacturer for joint type.

2.5 OPERABLE UNITS

- A. Doors: Comply with Division 08 Section "Aluminum-Framed Entrances and Storefronts".
- B. Windows: Comply with Division 08 Section "Aluminum Windows".

2.6 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762 mm) thickness per coat.

2.7 FABRICATION

- A. Form or extrude 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.
 3. Physical and thermal isolation of glazing from framing members.
 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
 6. Internal weeping system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum window wall to exterior.
- C. Curtain Wall Framing: Fabricate components for assembly using screw spline system following manufacturer's standard installation instructions.
- D. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Factory Finishing: Architect to select from manufacturer's full range of finishes and colors.

2.1 EXAMINATION

- A. Examine areas, 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.

2.2 INSTALLATION

- A. General: Install window wall systems plumb, level, and true to line, without warp or rack of frames with manufacturer's prescribed tolerances and installation instructions. Provide support and anchor in place.
 - 1. Dissimilar Materials: Provide separation of aluminum materials from sources of corrosion or electrolytic action contact points.
 - 2. Glazing: Glass shall be inside glazed or outside glazed and held in place with extruded aluminum glass stops.
 - 3. Water Drainage: Each light of glass shall be internally drained using water deflectors and sealant to divert water to the sill horizontal weep locations. Weep holes shall be located in the sill to divert water to the exterior of the building.
- B. Related Products Installation Requirements:
 - 1. Sealants (Perimeter): Refer to Joint Treatment (Sealants) Section.
 - 2. Glass: Refer to Glass and Glazing Section.
 - a. Reference: ANSI Z97.1, CPSC 16 CFR 1201 and GANA Glazing Manual.

2.3 FIELD QUALITY CONTROL

- A. Field Tests: Architect shall select window wall units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.
 - 1. Testing: Testing shall be performed per AAMA 503 by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements.
 - a. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², whichever is greater.
 - b. Water Infiltration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 8 psf (383 Pa).
- B. Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

2.4 ADJUSTING, CLEANING AND PROTECTION

- A. Protection: Protect installed product's finish surfaces from damage during construction. Protect aluminum window wall system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.

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- B. Cleaning: Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 084413

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. Cylinders specified for doors in other sections.

- C. Related Sections:

- 1. Division 08 Section "Hollow Metal Doors and Frames".
- 2. Division 08 Section "Interior Aluminum Doors and Frames".
- 3. Division 08 Section "Flush Wood Doors".
- 4. Division 08 Section "Aluminum-Framed Entrances and Storefronts".

- 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. 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. 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.

- E. 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.
- F. 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. 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.
- G. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- H. 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.
- I. 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
- J. At completion of installation, provide written documentation that components were applied 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 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. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual overhead door closer bodies.
4. Five years for motorized electric latch retraction exit devices.
5. Two years for electromechanical door hardware, unless noted otherwise.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

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. 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 certified 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).
- B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified 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 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. 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.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

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. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls 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. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
5. Manufacturers:
 - a. Rockwood (RO).

2.5 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. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C. 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.
- D. Removable Cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- E. 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. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.
 - 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. Sargent (SA) - Degree DG1.
- F. 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.
- G. 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).
- H. Construction Keying: Provide temporary keyed construction cores.
- I. Key Registration List (Bitting List):

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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.

2.6 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).

2.7 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. Where specified, provide status indicators with highly reflective color and wording for "locked/unlocked" or "vacant/occupied" with custom wording options if required. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status. Indicator window size to be a minimum of 2.1" x 0.6" with a curved design allowing a 180 degree viewing angle with protective covering to prevent tampering.
2. Manufacturers:
 - a. Sargent Manufacturing (SA) - 8200 Series.

2.8 ELECTROMECHANICAL LOCKING DEVICES

- A. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed, subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below and in the hardware sets.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.
2. 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.
3. Manufacturers:
 - a. Sargent Manufacturing (SA) - 8200 Series.

2.9 AUXILIARY LOCKS

- A. Mortise Deadlocks, Small Case: ANSI/BHMA A156.36, Grade 1, small case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. Steel or stainless steel bolts with a 1" throw and hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.
 - 1. Manufacturers:
 - a. Sargent Manufacturing (SA) - 4870 Series.
- B. Narrow Case Deadlocks and Deadlatches: ANSI/BHMA 156.13 Series 1000 Grade 1 certified narrow case deadlocks and deadlatches for swinging or sliding door applications. All functions shall be manufactured in a single sized case formed from 12 gauge minimum, corrosion resistant steel (option for fully stainless steel case and components). Provide minimum 2 7/8" throw laminated stainless steel bolt. Bottom rail deadlocks to have 3/8" diameter bolts.
 - 1. Manufacturers:
 - a. Adams Rite Manufacturing (AD) - MS1850S / MS1950 Series.

2.10 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.

2.11 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 - 1. 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.
 - 2. 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.
 - 3. 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.

4. 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.
 5. 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.
 6. 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.
 7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 9. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 10. 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.

2.12 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. Where conventional power supplies are not sufficient, include any specific controllers required to provide the proper inrush current.
 2. 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.
 3. Manufacturers:
 - a. Sargent Manufacturing (SA) - 80 Series.

2.13 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. Manufacturers:
 - a. Sargent Manufacturing (SA) - 351 Series.

2.14 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 certified 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).

2.15 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 certified 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).

2.16 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).

2.17 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.

2.18 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. MK - McKinney
- 2. PE - Pemko
- 3. RO - Rockwood
- 4. SA - SARGENT
- 5. AD - Adams Rite
- 6. OT - Other
- 7. SU - Securitron

****At aluminum frames gasketing / silencer is by frame manufacturer**

Set: 1.0

Doors: 1000A, 1000B, 1221, 1300

Description: Exterior Alum Main Entry - CVR/NLxEO - ELR - Deco Pulls - Closer - RX

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| | | | | |
|---|--------------------------------|------------------------------------|-------|----|
| 2 | Continuous Hinge | CFM__SLF-HD1 SER | | PE |
| 1 | Concealed Vert Rod Exit, MELR | DG164 55 56 AD8410 106 x Less Trim | US32D | SA |
| 1 | Concealed Vert Rod Exit, EO RX | 55 AD8410 EO | US32D | SA |
| 1 | Perm Core | DG1 6300 | US15 | SA |
| 2 | Pull | RM3131-24 Mtg-Type 12HD | US32D | RO |
| 2 | Surface Closer | TB 351 CPS brkt/spacer as req | EN | SA |
| 2 | Drop Plate | 351D as required | EN | SA |
| 1 | Threshold | 2005AT | | PE |
| 1 | Weatherstripping | By frame manufacturer | | 00 |
| 2 | Sweep | 308AV | | PE |
| 2 | ElectroLynx Harness | QC-C1500P | | MK |
| 2 | ElectroLynx Harness | QC-CxxxP | | MK |
| 1 | Card Reader | By Security Contractor | | OT |
| 1 | Power Supply | AQDx size as req | | SU |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Confirm hardware compatibility with aluminum door manufacturer.

Set: 2.0

Doors: 1001A, 1001B

Description: Exterior Alum Egress Pair - CVR/NLxEO - ELR - Door Pulls - Closer - RX

| | | | | |
|---|----------------------------------|-------------------------------|-------|----|
| 2 | Continuous Hinge | CFM__SLF-HD1 SER | | PE |
| 1 | Concealed Vert Rod Exit, DT RX | 55 AD8410 862 | US32D | SA |
| 1 | Concealed Vert Rod Exit, NL MELR | DG164 55 56 AD8410 106 x 862 | US32D | SA |
| 1 | Perm Core | DG1 6300 | US15 | SA |
| 2 | Surface Closer | TB 351 CPS brkt/spacer as req | EN | SA |
| 2 | Drop Plate | 351D as required | EN | SA |
| 1 | Threshold | 2005AT | | PE |
| 1 | Weatherstripping | By frame manufacturer | | 00 |
| 2 | Sweep | 308AV | | PE |
| 2 | ElectroLynx Harness | QC-C1500P | | MK |
| 2 | ElectroLynx Harness | QC-CxxxP | | MK |
| 1 | Card Reader | By Security Contractor | | OT |
| 1 | Power Supply | AQDx size as req | | SU |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Confirm hardware compatibility with aluminum door manufacturer.

Set: 3.0

Doors: 1027A, 1027B, 1110, 1200

Description: Exterior Alum Egress Sgl - Rim/NL - MELR - Card Access - Door Pulls - Closer - RX

| | | | | |
|---|--------------------------|-------------------------------|-------|----|
| 1 | Continuous Hinge | CFM__SLF-HD1 SER | | PE |
| 1 | Rim Exit Device, NL MELR | DG164 55 56 AD8504 862 | US32D | SA |
| 1 | Perm Core | DG1 6300 | US15 | SA |
| 1 | Surface Closer | TB 351 CPS brkt/spacer as req | EN | SA |
| 1 | Threshold | 2005AT | | PE |

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| | | | |
|-----------------------|------------------------|--|----|
| 1 Weatherstripping | By frame manufacturer | | 00 |
| 1 Sweep | 308AV | | PE |
| 1 ElectroLynx Harness | QC-C1500P | | MK |
| 1 ElectroLynx Harness | QC-CxxxP | | MK |
| 1 Card Reader | By Security Contractor | | OT |
| 1 Power Supply | AQDx size as req | | SU |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Confirm hardware compatibility with aluminum door manufacturer.

Set: 4.0

Doors: 1015B, 1015F, 1018B

Description: Exterior Alum Egress Sgl - Rim/NL - Door Pulls - Closer

| | | | |
|----------------------------|-------------------------------|-------|----|
| 1 Continuous Hinge | CFM_SLF-HD1 | | PE |
| 1 Rim Exit Device, NL Alum | DG164 AD8504 862 | US32D | SA |
| 2 Perm Core | DG1 6300 | US15 | SA |
| 1 Surface Closer | TB 351 CPS brkt/spacer as req | EN | SA |
| 1 Threshold | 2005AT | | PE |
| 1 Weatherstripping | By frame manufacturer | | 00 |
| 1 Sweep | 308AV | | PE |

Notes: Confirm all hardware compatibility with aluminum storefront manufacturer.

Set: 5.0

Doors: 2002

Description: Exterior Alum Sgl - DB x Push/Pulls - Closer

| | | | |
|--------------------|-------------------------------|-------|----|
| 1 Continuous Hinge | CFM_SLF-HD1 | | PE |
| 1 Mortise Deadlock | MS1850S | 628 | AD |
| 2 Cylinder | DG1 xx As Req | US32D | SA |
| 2 Perm Core | DG1 6300 | US15 | SA |
| 1 Push Bar & Pull | BF15747 | US32D | RO |
| 1 Surface Closer | TB 351 CPS brkt/spacer as req | EN | SA |
| 1 Threshold | 2005AT | | PE |
| 1 Weatherstripping | By frame manufacturer | | 00 |
| 1 Sweep | 308AV | | PE |

Notes: Confirm all hardware compatibility with aluminum storefront manufacturer.

Verify locking arrangement with local authorities.

Set: 6.0

Doors: 1028B, 1310B

Description: Exterior Sgl - Rim/NL - Closer/stop

| | | | |
|-------------------------------|-------------------------------|-------|----|
| 4 Hinge, Full Mortise, Hvy Wt | T4A3386 NRP | US32D | MK |
| 1 Rim Exit Device, NL | DG164 8804 862 | US32D | SA |
| 1 Perm Core | DG1 6300 | US15 | SA |
| 1 Surface Closer | TB 351 CPS brkt/spacer as req | EN | SA |
| 1 Kick Plate | K1050 10" BEV CSK | US32D | RO |

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| | | | | |
|---|------------|--------------------|--|----|
| 1 | Threshold | 2005AT | | PE |
| 1 | Rain Guard | 346C x Frame Width | | PE |
| 1 | Gasketing | 303AS | | PE |
| 1 | Sweep | 308AV | | PE |

Set: 7.0

Doors: 1100, 2200, 2300, 2400

Description: Interior Sgl Alum Access Control MELR - Door Pulls - Closer

| | | | | |
|---|-----------------------------|-------------------------------|-------|----|
| 3 | Hinge (heavy weight) | T4A3786 | US26D | MK |
| 1 | Hinge, Full Mortise, Hvy Wt | T4A3786 QC | US26D | MK |
| 1 | Rim Exit Device, NL MELR | DG164 55 56 AD8504 862 | US32D | SA |
| 1 | Perm Core | DG1 6300 | US15 | SA |
| 1 | Surface Closer | TB 351 CPS brkt/spacer as req | EN | SA |
| 1 | Drop Plate | 351D as required | EN | SA |
| 1 | ElectroLynx Harness | QC-C1500P | | MK |
| 1 | ElectroLynx Harness | QC-CxxxP | | MK |
| 1 | Card Reader | By Security Contractor | | OT |
| 1 | Power Supply | AQDx size as req | | SU |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Set: 8.0

Doors: 1005A, 1016, 2275

Description: Interior Sgl Alum Access Control DL x ES - Lever- Closer

| | | | | |
|---|---------------------|-------------------------------|-------|----|
| 4 | Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 | Deadlatch | 4900 | 628 | AD |
| 1 | Lever Operator | 4600 (2190) MD | US32D | AD |
| 1 | Trim | 3080 MD 3 | US32D | AD |
| 1 | Cylinder | DG1 xx As Req | US32D | SA |
| 1 | Perm Core | DG1 6300 | US15 | SA |
| 1 | Electric Strike | 7100 | 628 | AD |
| 1 | Surface Closer | TB 351 CPS brkt/spacer as req | EN | SA |
| 1 | Drop Plate | 351D as required | EN | SA |
| 1 | Gasketing | By frame manufacturer | | OT |
| 1 | ElectroLynx Harness | QC-C1500P | | MK |
| 1 | Card Reader | By Security Contractor | | OT |
| 1 | Power Supply | AQDx size as req | | SU |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Set: 9.0

Doors: 2102

Description: Interior Sgl Alum NL - Door Pulls - Closer

| | | | | |
|---|--------------------------|-------------------------------|-------|----|
| 4 | Hinge (heavy weight) | T4A3786 | US26D | MK |
| 1 | Rim Exit Device, NL Alum | DG164 AD8504 862 | US32D | SA |
| 1 | Perm Core | DG1 6300 | US15 | SA |
| 1 | Surface Closer | TB 351 CPS brkt/spacer as req | EN | SA |

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| | | | |
|--------------|-----------------------|----|----|
| 1 Drop Plate | 351D as required | EN | SA |
| 1 Gasketing | By frame manufacturer | | OT |

Notes: Confirm hardware compatibility with aluminum door manufacturer.

Set: 10.0

Doors: 1018A, 1025

Description: Interior Sgl Alum Classroom Exit- Closer

| | | | |
|------------------------------|--------------------------|-------|----|
| 4 Hinge (heavy weight) | T4A3786 | US26D | MK |
| 1 Rim Exit Device, Classroom | DG164 AD8513 ETMB | US32D | SA |
| 1 Perm Core | DG1 6300 | US15 | SA |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Drop Plate | 351D as required | EN | SA |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | By frame manufacturer | | OT |

Notes: Confirm hardware compatibility with aluminum door manufacturer.

Set: 11.0

Doors: 1007

Description: Alum Sgl - Unsecured - Door Pull -Closer

| | | | |
|---------------------------|--------------------------|-------|----|
| 4 Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 Push Bar & Pull | BF15747 | US32D | RO |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Drop Plate | 351D as required | EN | SA |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | By Door Manufacturer | | OT |

Notes: Confirm all hardware compatibility with aluminum storefront manufacturer.

Set: 12.0

Doors: 1015A

Description: Int Alum Pair - CVR Exit /Classroom - Lever -Closer

| | | | |
|--------------------------------------|--------------------------|-------|----|
| 6 Hinge (heavy weight) | T4A3786 | US26D | MK |
| 2 Concealed Vert Rod Exit, Classroom | DG164 AD8413 ETMB | US32D | SA |
| 2 Perm Core | DG1 6300 | US15 | SA |
| 2 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 2 Drop Plate | 351D as required | EN | SA |
| 2 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | By Door Manufacturer | | OT |

Notes: Confirm all hardware compatibility with aluminum storefront manufacturer.

Set: 13.0

Doors: 1014A, 1014C

Description: Int Alum Sgl - Door Pulls - DB- Closer

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| | | | |
|------------------------|-----------------------|-------|----|
| 4 Hinge (heavy weight) | T4A3786 | US26D | MK |
| 1 Mortise Deadlock | MS1850S | 628 | AD |
| 1 Lever | 4550-01 | 130 | AD |
| 1 Cylinder | DG1 xx As Req | US32D | SA |
| 1 Perm Core | DG1 6300 | US15 | SA |
| 1 Push Bar & Pull | BF15747 | US32D | RO |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Drop Plate | 351D as required | EN | SA |
| 1 Gasketing | By Door Manufacturer | | OT |

Notes: Confirm all hardware compatibility with aluminum storefront manufacturer.

Set: 14.0

Doors: [1028A](#), [2239](#)

Description: Interior Sgl Rated Passage - Rim - Closer

| | | | |
|----------------------------|--------------------------|-------|----|
| 4 Hinge (heavy weight) | T4A3786 | US26D | MK |
| 1 Rim Exit Device, Passage | 12 8815 ETMB | US32D | SA |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Kick Plate | K1050 10" BEV CSK | US32D | RO |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | S88D (Head and Jambs) | | PE |

Notes: Closer inside stairwell.

Set: 15.0

Doors: [2418](#)

Description: Interior Sgl Rated Fail Safe - Rim - Closer

| | | | |
|-------------------------------|--------------------------|-------|----|
| 3 Hinge (heavy weight) | T4A3786 | US26D | MK |
| 1 Hinge, Full Mortise, Hvy Wt | T4A3786 QC | US26D | MK |
| 1 Fail Safe Exit Device | DG164 12 55 8875 ETMB | US32D | SA |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Kick Plate | K1050 10" BEV CSK | US32D | RO |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | S88D (Head and Jambs) | | PE |
| 1 ElectroLynx Harness | QC-C1500P | | MK |
| 1 ElectroLynx Harness | QC-CxxxP | | MK |
| 1 Card Reader | By Security Contractor | | OT |
| 1 Power Supply | AQDx size as req | | SU |

Notes: Closer inside stairwell. Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will unlock allowing free entry - fail safe operation. Free egress at all times.

Set: 16.0

Doors: [1310A](#)

Description: Interior Sgl Rated Classroom Exit - Closer

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| | | | |
|------------------------------|--------------------------|-------|----|
| 4 Hinge (heavy weight) | T4A3786 | US26D | MK |
| 1 Rim Exit Device, Classroom | DG164 12 8813 ETMB | US32D | SA |
| 1 Perm Core | DG1 6300 | US15 | SA |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Kick Plate | K1050 10" BEV CSK | US32D | RO |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | S88D (Head and Jambs) | | PE |

Notes: Closer inside stairwell.

Set: 17.0

Doors: 1006

Description: Int SVR Lockable Lever (CR)- Closer

| | | | |
|------------------------------------|--------------------------|-------|----|
| 8 Hinge (heavy weight) | T4A3786 | US26D | MK |
| 2 Surface Vert Rod Exit, Classroom | DG164 NB8713 ETMB | US32D | SA |
| 2 Perm Core | DG1 6300 | US15 | SA |
| 2 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 2 Kick Plate | K1050 10" BEV CSK | US32D | RO |
| 2 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 2 Silencer | 608 / 609 | | RO |

Notes: Confirm hardware compatibility with door supplier.

Set: 18.0

Doors: 1005B, 1302B, 1305, 1306A, 1320B, 2101B, 2218

Description: Interior Sgl - Access Control Lock- Closer - W/F Stop

| | | | |
|---------------------------|--------------------------|-------|----|
| 1 Hinge, Full Mortise | TA2714 QC* | US26D | MK |
| 3 Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 Fail Secure Lock | DG164 RX 8271 E2MB | US26D | SA |
| 1 Perm Core | DG1 6300 | US15 | SA |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Kick Plate | K1050 10" BEV CSK | US32D | RO |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 3 Silencer | 608 / 609 | | RO |
| 1 ElectroLynx Harness | QC-C1500P | | MK |
| 1 ElectroLynx Harness | QC-CxxxP | | MK |
| 1 Card Reader | By Security Contractor | | OT |
| 1 Power Supply | AQDx size as req | | SU |

Notes: Door is normally closed and secure. Presentation of valid credential allows entry by trim. Upon loss of power, door will remain secure. Free egress at all times.

Set: 19.0

Doors: 1008, 1024, 1124, 1209, 1232, 1246, 1268, 1271, 1319, 2221, 2248, 2424, 2435

Description: Interior Storage Sgl - Storeroom - W/F Stop

| | | | |
|---------------------------|--------------------------|-------|----|
| 4 Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 Storeroom/Closet Lock | DG164 8204 E2MB | US26D | SA |
| 1 Perm Core | DG1 6300 | US15 | SA |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 3 Silencer | 608 / 609 | | RO |

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Set: 20.0

Doors: 1021, 1317, 2276, 2416

Description: Interior Storage Sgl - Storeroom - Closer - W/F Stop

| | | | |
|---------------------------|--------------------------|-------|----|
| 4 Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 Storeroom/Closet Lock | DG164 8204 E2MB | US26D | SA |
| 1 Perm Core | DG1 6300 | US15 | SA |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Kick Plate | K1050 10" BEV CSK | US32D | RO |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 3 Silencer | 608 / 609 | | RO |

Set: 21.0

Doors: 1022, 1210, 1217, 1252, 1309, 2104, 2206, 2247, 2261, 2277, 2408, 2417, 2430

Description: Interior Sgl - Storeroom - Closer - W/F Stop - Gasket

| | | | |
|---------------------------|--------------------------|-------|----|
| 4 Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 Storeroom/Closet Lock | DG164 8204 E2MB | US26D | SA |
| 1 Perm Core | DG1 6300 | US15 | SA |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Kick Plate | K1050 10" BEV CSK | US32D | RO |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | S88D (Head and Jamb) | | PE |

Set: 22.0

Doors: 1023

Description: Interior Storage Pr - Storeroom - Closer/stop - MFB

| | | | |
|-------------------------|-----------------------|-------|----|
| 8 Hinge, Full Mortise | TA2714 | US26D | MK |
| 2 Flush Bolt | 555 12" / 72" AFF | US26D | RO |
| 1 Dust Proof Strike | 570 | US26D | RO |
| 1 Storeroom/Closet Lock | DG164 8204 E2MB | US26D | SA |
| 1 Perm Core | DG1 6300 | US15 | SA |
| 1 Surface Overhead Stop | 59xS | EN | SA |
| 1 Surface Closer | TB 351 PS | EN | SA |
| 1 Gasketing | By frame manufacturer | | OT |

Notes: Closer on active leaf, overhead stop on inactive

Set: 23.0

Doors: 2240

Description: Interior Office Sgl - Office - Closer - W/F Stop

| | | | |
|---------------------------|--------------------------|-------|----|
| 4 Hinge, Full Mortise | T2714 | US26D | MK |
| 1 Office/Entry Lock | DG164 8205 E2MB | US26D | SA |
| 1 Perm Core | DG1 6300 | US15 | SA |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Kick Plate | K1050 10" BEV CSK | US32D | RO |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | By frame manufacturer | | OT |
| 1 Coat Hook | RM823 | US32D | RO |

Set: 24.0

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Doors: 1101, 1102, 1103, 1104, 1106, 1107, 1108, 1109, 1111, 1112, 1113, 1114, 1116, 1118, 1120, 1121, 1122, 1201A, 1201B, 1203, 1204, 1206, 1207, 1208, 1218, 1219, 1220A, 1220B, 1222A, 1222B, 1223, 1224, 1225, 1226, 1233, 1234, 1236, 1237, 1238, 1240, 1241, 1242, 1247, 1248, 1249, 1250, 1251, 1253, 1254, 1255, 1256, 1257, 1259, 1260, 1261, 1262, 1263, 1264, 1265, 1266, 1267, 1270, 1301, 1302A, 1311, 1312, 1313, 1314, 1315, 1316, 1320A, 2101A, 2201, 2202, 2207, 2208, 2214, 2215, 2216, 2219, 2220, 2222, 2230, 2231, 2232, 2234, 2235, 2236, 2241, 2242, 2243, 2245, 2246, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2262, 2263, 2264, 2265, 2267, 2269, 2270, 2271, 2272, 2273, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2409, 2410, 2411, 2414, 2415, 2419, 2420, 2421, 2422, 2423, 2425, 2426, 2429, 2433, 2434, 2437, 2438, 2439, 2440, 2441, 2442

Description: Interior Office Sgl - Office - W/F Stop

| | | | |
|---------------------------|--------------------------|-------|----|
| 4 Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 Office/Entry Lock | DG164 8205 E2MB | US26D | SA |
| 1 Perm Core | DG1 6300 | US15 | SA |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | By frame manufacturer | | OT |
| 1 Coat Hook | RM823 | US32D | RO |

Set: 25.0

Doors: 1125A, 1125B, 1126, 1211, 1306B, 2224, 2228A, 2228B, 2268

Description: Interior Classroom

| | | | |
|---------------------------|--------------------------|-------|----|
| 4 Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 Classroom Lock | DG164 8237 E2MB | US26D | SA |
| 1 Perm Core | DG1 6300 | US15 | SA |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 3 Silencer | 608 / 609 | | RO |

Set: 26.0

Doors: 1019C, 1020C, 2106E, 2107D

Description: Interior Toilet Sgl - Privacy - ADA W/F stop - 7'

| | | | |
|---------------------------|--------------------------|-------|----|
| 3 Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 Privacy Set | V20 8265 VN1MB | US26D | SA |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | By frame manufacturer | | OT |

Set: 27.0

Doors: 1011D, 1012E

Description: Interior Toilet Sgl - Privacy - ADA W/F stop - 8'

| | | | |
|---------------------------|--------------------------|-------|----|
| 4 Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 Privacy Set | V20 8265 VN1MB | US26D | SA |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | By frame manufacturer | | OT |

Set: 28.0

Doors: 1013, 1214, 1216, 1228, 1229, 1230, 1231, 1304, 1307, 2210, 2211, 2212, 2213, 2431, 2432

Description: Interior - Privacy - Closer - W/F stop

| | | | |
|-----------------------|-----------------------|-------|----|
| 4 Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 Privacy Set | V20 8265 VN1MB | US26D | SA |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |

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| | | | |
|---------------------------|--------------------------|-------|----|
| 1 Kick Plate | K1050 10" BEV CSK | US32D | RO |
| 1 Mop Plate | K1050 4" BEV CSK | US32D | RO |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | S88D (Head and Jamb) | | PE |

Set: 29.0

Doors: 2106B, 2106C, 2106D, 2107B, 2107C
Description: Interior Toilet Stall - 7'

| | | | |
|---------------------------|--------------------------|-------|----|
| 3 Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 Privacy Set | V20 8265 VN1MB | US26D | SA |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | By frame manufacturer | | OT |

Set: 30.0

Doors: 1011B, 1011C, 1012B, 1012C, 1012D
Description: Interior Toilet Stall - 8'

| | | | |
|---------------------------|--------------------------|-------|----|
| 4 Hinge, Full Mortise | TA2714 | US26D | MK |
| 1 Privacy Set | V20 8265 VN1MB | US26D | SA |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | By frame manufacturer | | OT |

Set: 31.0

Doors: 1011A, 1012A, 1019B, 1020B, 2106A, 2107A
Description: Interior Restrooms/Locker Shared - Push/Pull - Closer - W/F Stop

| | | | |
|---------------------------|--------------------------|-------|----|
| 4 Hinge (heavy weight) | T4A3786 | US26D | MK |
| 1 Pull Plate - 4" x 16" | 107x70C | US32D | RO |
| 1 Push Plate - 4" x 16" | 70C | US32D | RO |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Kick Plate | K1050 10" BEV CSK | US32D | RO |
| 1 Mop Plate | K1050 4" BEV CSK | US32D | RO |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | By frame manufacturer | | OT |

Set: 32.0

Doors: 1019A, 1020A
Description: Interior Restrooms/Locker Shared - Push/Pull - DB Closer - W/F Stop

| | | | |
|---------------------------|--------------------------|-------|----|
| 4 Hinge (heavy weight) | T4A3786 | US26D | MK |
| 1 Public Toilet Deadlock | DG164 4878 | US26D | SA |
| 2 Perm Core | DG1 6300 | US15 | SA |
| 1 Pull Plate - 4" x 16" | 107x70C | US32D | RO |
| 1 Push Plate - 4" x 16" | 70C | US32D | RO |
| 1 Surface Closer | TB 351 UO / PS as req | EN | SA |
| 1 Kick Plate | K1050 10" BEV CSK | US32D | RO |
| 1 Mop Plate | K1050 4" BEV CSK | US32D | RO |
| 1 Floor Stop or Wall Stop | 441CU or 406 as Required | US26D | RO |
| 1 Gasketing | By frame manufacturer | | OT |

Notes: Thumbturn inside retracts deadbolt but will not project it

Set: 33.0

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Doors: 1014B, 1015G

Description: Aluminum Biparting Sliders

1 All Hardware

By Door Manufacturer

OT

Notes: Confirm PH2 Doors

Set: 34.0

Doors: 1015C, 1015D, 1015E, 1018C

Description: OH Coiling

1 Cylinder

DG1 xx As Req

US32D

SA

1 Perm Core

DG1 6300

US15

SA

1 Balance of Hardware

by door manufacturer.

OT

Notes: Confirm cylinder type required.

END OF SECTION 087100

SECTION 08810 - ARCHITECTURAL GLASS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. High performance glass of the following types:
 - 1. Low-e insulating glass.

1.2 RELATED SECTIONS

- A. Section 084113 – Aluminum-Framed Entrances & Storefronts
- B. Section 084413 - Glazed Aluminum Curtain Walls.

1.3 REFERENCES

- A. ANSI Z97.1 - American National Standard for Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- B. ASCE 7 - "Minimum Design Loads for Buildings and Other Structures".
- C. ASTM International (ASTM):
 - 1. ASTM C 162 - Standard Terminology of Glass and Glass Products.
 - 2. ASTM C 1036 - Standard Specification for Flat Glass.
 - 3. ASTM C 1048 - Standard Specification for Heat-Treated Flat Glass -- Kind HS, Kind FT Coated and Uncoated Glass.
 - 4. ASTM C 1172 - Standard Specification for Laminated Architectural Flat Glass.
 - 5. ASTM C 1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
 - 6. ASTM E 2188 - Standard Test Method for Insulating Glass Unit Performance.
 - 7. ASTM E 2189 - Standard Test Method for Testing Resistance to Fogging in Insulating Glass Units.
 - 8. ASTM E 2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.

1.4 DEFINITIONS

- A. Manufacturers of Glass Products: 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 that contains dehydrated air or other specified gas.
- D. Sealed Insulating Glass Unit Surface Designations:
 - 1. Surface 1 - Exterior surface of the outer glass lite.
 - 2. Surface 2 - Interspace surface of the outer glass lite.
 - 3. Surface 3 - Interspace surface of the inner glass lite.
 - 4. Surface 4 - Interior surface of the inner glass lite.

1.5 PERFORMANCE REQUIREMENTS

- A. General: Provide glass capable of withstanding thermal movement and wind and impact loads (where applicable) as specified in paragraph B following.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. 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.
 - 1) Reference Structural Drawings for design loads.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from ambient and surface temperatures changes acting on glass framing members and glazing components.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
 - 1. For monolithic glass lites, properties are based on units with lites 1/4 inch (6.0 mm) thick.
 - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 3. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. per h per degree F.
 - b. Solar Heat Gain Coefficient: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: For each glass product and glazing material indicated.
- C. Verification Samples: For the following products, in the form of 12 inch (305 mm) square samples for insulating glass units. (2 Samples Minimum) (One to Owner / One to Architect for review and approval)
- D. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- E. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
 - 1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.
- F. Qualification Data: For installers.
- G. Product Test Reports: For each of the following types of glazing products.
 - 1. Insulating glass.

- H. Warranties: Special warranties specified in this Section.

1.7 QUALITY ASSURANCE

- A. Sustainable Design Certification: Glass shall be Cradle to Cradle Certified, minimum Level, Cradle to Cradle Innovation Institute.
- B. Fabricator Qualifications: Vitro Certified Fabricator Network, as acceptable to the manufacturer.
- C. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level-2 (Senior Glaziers) or Level-3 (Master Glaziers). Provide Architect with a copy of the Qualifications for review.
- D. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: Clear float glass, coated float glass and insulating glass.
- E. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified independent testing agency accredited according to the NFRC CAP1 Certification Agency Program.
- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and industry organizations, including but not limited to those 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. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
 - 2. GANA Publications: "Laminated Glazing Reference Manual"; "Glazing Manual."
 - 3. AAMA: "Sloped Glazing Guidelines."
 - 4. IGMA: "Guidelines for Sloped Glazing."
- G. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
 - 1. Insulating Glass Certification Council.
 - 2. Associated Laboratories, Inc.
 - 3. Insulating Glass Manufacturers Alliance.
- H. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, Insulating Glass Manufacturers Alliance ANSI Z97.1.
 - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
 - 2. Lites more than 9 sq ft (0.84 sq m) in area are required to be Category II materials.
 - 3. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sf (0.84 sq m) in area, provide glazing products that comply with Category II materials, and for lites 9 sf (0.84 sq m) or less in area, provide glazing products that comply with Category I or II materials.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

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- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.9 WARRANTY

- A. Manufacturer's Warranty for Coated-Glass Products: Manufacturer's standard form, made out to the glass fabricator in which the coated glass manufacturer agrees to replace coated glass units that deteriorates during normal use within the specified warranty period. Deterioration of the coated glass is defined as peeling and/or cracking, or discoloration that is not attributed to glass breakage, seal failure, improper installation, or cleaning and maintenance that is contrary to the manufacturer's written instructions.

- 1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Warranty on Insulating Glass: Manufacturer's standard form in which the insulating glass unit manufacturer agrees to replace insulating-glass units that deteriorate during normal use within the specified warranty period. Deterioration of insulating glass units is defined as an obstruction of vision by dust, moisture, or a film on the interior surfaces of the glass caused by a failure of the hermetic seal that is not attributed to glass breakage, improper installation, or cleaning and maintenance that is contrary to the manufacturer's written instructions.

- 1. Warranty Period: 10 years from date of Substantial Completion.

- C. Manufacturer's Warranty on Laminated Glass: Manufacturer's standard form in which the laminated glass manufacturer agrees to replace laminated glass units that deteriorate during normal use within the specified warranty period. Deterioration of laminated glass is defined as defects, such as discoloration, edge separation, or blemishes exceeding those allowed by ASTM C 1172 that are not attributed to glass breakage, improper installation, or cleaning and maintenance that is contrary to the manufacturer's written instructions.

- 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Vitro Architectural Glass; Glass Technology Center, 400 Guys Run Rd., Pittsburgh, PA 15024. ASD. Toll Free Tel: (800) 887-6457. Fax: (800) 367-2986. Web: <http://www.vitroglazings.com>.
- B. Requests for substitutions will be considered in accordance with provisions of Section 012500.

2.2 GLASS PRODUCTS

- A. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.

- 1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 - 2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated or required.
 - 3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

4. Sealing System: Comply with requirements in Section 07920 - Joint Sealants. Dual seal, with primary and secondary sealants of polyisobutylene and silicone.
5. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
 - a. Spacer Material: Aluminum with mill or clear anodic finish.
 - b. Desiccant: Molecular sieve or silica gel, or blend of both.
 - c. Corner Construction: Manufacturer's standard corner construction.

2.3 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze 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.

2.4 GLASS SCHEDULE, INSULATING GLASS

- A. Type: Low-E Tinted Insulating Glass - Light-gray, ultra-neutral low-reflective exterior appearance.
 1. Solarban 70 (2) Optigray + Clear by Vitro Architectural Glass.
 2. Performance Values: VLT 46 percent; SHGC 0.23; shading coefficient 0.26; exterior reflectance 9 percent; U-value winter 0.28; U-value summer 0.26.
 3. Insulating Glass Unit Construction: 1/4 inch (6 mm) Optigray glass, Solarban 70 solar control (sputtered) on second surface (2) + 1/2 inch (13 mm) air space + 1/4 inch (6 mm) Clear glass

2.5 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.
- 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.

2.6 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 weather tight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weather tight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

2.7 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.

PART 3 EXECUTION (Not Used.)

END OF SECTION

092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Provide delegated design cold-formed metal framing by one of the following:

1. Allied Studco, Inc.
2. ClarkDietrich Building Systems.
3. Marino Ware Industries.
4. The STEEL Network, Inc.
5. Unimast Incorporated.
6. Delta Metal Products.
7. Wheeling Corrugating Co.
8. Nucor Building Components.
9. Or approved equal.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized unless otherwise indicated.

C. Studs and Runners: ASTM C 645.

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1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.0269 inch (23 ga.) (0.683 mm) except 0.0296 inch (22 ga.) (0.752 mm) at walls with ceramic tile.
 - b. Depth: 4 inches (92 mm) and 6 inches (152 mm) where shown on plans.

 - D. Slip-Type Head Joints: Where studs intersect with roof structure, provide the following:
 1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 - a. Provide products by one of the following:
 - 1) Fire Trak Corporation.
 - 2) The STEEL Network, Inc.
 - 3) ClarkDietrich Building Systems.
 - 4) Or approved equal.

 - E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich Building Systems.
 - b. MRI Steel Framing, LLC.
 2. Minimum Base-Metal Thickness: 0.0296 inch (0.752 mm) (22 ga.).

 - F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum ½-inch- (13-mm-) wide flanges.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich Building Systems.
 - b. MRI Steel Framing, LLC.
 2. Depth: 1-1/2 inches (38 mm).
 3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

 - G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 1. Minimum Base-Metal Thickness: 0.0296 inch (0.752 mm).
 2. Depth: 7/8 inch (22.2 mm) or as shown on plans.
-
- ### 2.3 SUSPENSION SYSTEMS
- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

 - B. Hanger Attachments to Steel Framing:
 1. Screw type attachment or welding.

 - C. Hangers: Steel stud hangers in minimum 4 inch width or as indicated on drawings.

 - D. Furring Channels (Furring Members):
 1. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: As indicated on Drawings and not less than 0.0296 inch (0.752 mm).
 - b. Depth: As indicated on Drawings or required for furring application.
 2. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.

- a. Minimum Base-Metal Thickness: 0.0296 inch (0.752 mm).

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 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 framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing to just above suspended ceilings where shown on plans or to full height to structural supports or substrates above suspended ceilings where shown on plans. Continue framing around ducts that penetrate partitions above ceiling.
 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.

- b. Install cripple studs at head adjacent to each jamb stud, with a minimum ½-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
- c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure where required by plans.
3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

3.3 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Suspend hangers from building structure 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 suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads.
 3. Stud Hangers: Secure to structure, including intermediate framing members, by attaching to the structure above so that framing is secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Do not attach hangers to steel roofing.
 5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- C. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 09 29 00 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing and furring for gypsum board assemblies.
2. Gypsum board assemblies attached to steel framing and furring.
3. Exterior gypsum board panels for ceilings and soffits.
4. Water-resistant gypsum board.
5. Sound attenuation insulation in partition stud spaces.
6. Joint treatment materials.
7. Acoustical sealant.
8. Fasteners.
9. Partition identification (stenciling fire-rated walls).

B. Related Sections:

1. Section 054000 - Cold Formed Metal Framing: Steel studs and "C" shaped steel joists for structural framing constructed of 18 gauge or heavier material.
2. Section 072100 -Building Insulation: Thermal batt insulation.
3. Section 078413 – Firestopping.
4. Section 092550 - Exterior Sheathing: Sheathing installed on exterior walls.
5. Section 092650 - Gypsum Board Shaft Wall: Gypsum board shaft wall systems.
6. Section 093000 - Ceramic Tile: Cementitious backer units for application of tile.
7. Section 099100 – Painting: Painting of gypsum Board walls.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product specifications and installation recommendations for each product proposed.

B. Shop Drawings: Show Control joint locations and areas requiring additional blocking for structural stability of wall mounted items.

C. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
2. Finish level mockups: Prior to finishing gypsum board assemblies, construct mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects of each finish level specified as well as qualities of material and execution. Simulate finished lighting conditions for review in place unit of work. Notify designer (7) days prior to mockup review. Obtain Designer approval before start of final unit of work. Retain and maintain mock ups during construction in and undisturbed condition as a standard for judging the completed work. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of finished work.

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QUALITY ASSURANCE

- D. Reference Standards: Comply with applicable requirements of ASTM C 754 (Installation of Steel Framing Members to Receive Screw-Attached Gypsum Wallboard, Backing Board, or Water-Resistant Backing Board) and ASTM C 840 (Application and Finishing of Gypsum Board), both as supplemented by this Section.
- E. Sound Transmission Characteristics: For gypsum board assemblies indicated to have STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing agency.
- F. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to assemblies tested for fire resistance per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Provide indicated fire-resistance rated assemblies identified in UL "Fire Resistance Directory" or other testing and inspecting agency acceptable to authorities having jurisdiction.
- G. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

1.3 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 contamination, 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.

1.4 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. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- D. Room Temperatures: For attachment of gypsum board to framing, 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. Avoid conditions that result in gypsum veneer plaster drying too rapidly.
- E. Protection: Protect gypsum board products from direct exposure to rain, snow, sunlight, or other excessive weather conditions.

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- F. 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

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering acceptable products include, but are not limited to, the following:
 - 1. Steel Framing and Furring:
 - a. ALABAMA METAL INDUSTRIES CORP.
 - b. METALPRO INC
 - c. CLARK STEEL FRAMING
 - d. DALE/INCOR INDUSTRIES, INC.
 - e. MARINO INDUSTRIES CORP.
 - f. GOLD BOND BUILDING PRODUCTS DIV., NATIONAL GYPSUM CO.
 - g. UNIMAST INC.
 - 2. Grid Suspension Assemblies:
 - a. CHICAGO METALLIC CORP.
 - b. ARMSTONG.
 - c. NATIONAL ROLLING MILLS CO.
 - d. USG INTERIORS, INC.
 - 3. Gypsum Board and Related Products:
 - a. UNITED STATES GYPSUM CO.
 - b. DOMTAR GYPSUM.
 - c. GEORGIA-PACIFIC CORP.
 - d. NATIONAL GYPSUM CO.

2.2 STEEL FRAMING COMPONENTS FOR 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. 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.
 - 2. Protective Coating: ASTM A 653, G 40 (ASTM A 653M, Z 90) hot-dip galvanized coating.

2.3 STEEL FRAMING FOR WALLS AND PARTITIONS

- A. General: Provide steel framing members complying with the following requirements:
 - 1. Component Sizes and Spacings: As indicated but not less than that required to comply with ASTM C 754 for maximum deflection of L/360 at 5 lbs. per sq. ft. lateral loading.
 - 2. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized.

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- B. Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch-wide minimum lip (return) and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
1. Nominal 20 gauge minimum unless otherwise indicated on Drawings.
 2. Nominal 20 gauge minimum at walls receiving ceramic tile finish.
 3. Nominal 16 gauge minimum at door jambs (two studs at each jamb)
 4. Depth: As indicated on drawings.
- C. Vertical Deflection: Unless otherwise indicated on Drawings, all interior non-load-bearing light gauge steel framing which extends to the structure above shall be designed to accommodate a minimum of 1/2" vertical deflection using minimum 2" extended leg ceiling runners and deflection slide clips.
1. Deflection Clip: Flex-C 3 Legged Dog
 2. Approved equal.
- D. Deflection and Firestop Track (for fire-rated partitions): Top runner shall be designed to allow partition heads to expand and contract with movement of structure above while maintaining continuity of the fire-rated assembly. Comply with requirements of ASTM C 645 except configuration, of thickness indicated for studs and width to accommodate depth of studs indicated with flanges offset at midpoint to accommodate gypsum board thickness.
1. Provide for minimum vertical deflection specified above.
 2. Refer to drawings for details. If not detailed, provide manufacturer's standard offset configuration.
- E. Steel Rigid Furring Channels: ASTM C 645, hat-shaped, 7/8-inch depth and 0.0179-inch (nominal 25 ga.) minimum thickness of base (uncoated) metal.
- F. Steel Channel Bridging: Cold-rolled steel, 0.0598-inch (1.5-mm) minimum thickness of base (uncoated) metal and 7/16-inch- (11.1-mm-) wide flanges, 1-1/2 inches (38.1 mm) deep, 475 lb/1000 feet (45 kg/100 m), unless otherwise indicated.
- G. Steel Flat Strap and Backing Plate (If Required): Steel sheet for blocking and bracing complying with ASTM A 653 (ASTM A 653M) or ASTM A 568 (ASTM A 568M), length and width as indicated, and with a minimum base metal (uncoated) thickness as follows:
1. Thickness: 0.027 inch (0.7 mm) unless otherwise indicated or otherwise required by manufacturer of items being installed.
- H. Z-Clips: At underside of steel beams to receive fireproofing provide and securely fasten z-clips to anchor deflection tracks. Spacing and gauge shall match that of stud below.
- I. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

2.4 GYPSUM BOARD PRODUCTS

- 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.
1. Widths: 48 inches (1219 mm).
- B. Gypsum Board: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent, 5/8 inch thick or as otherwise indicated on drawings.
1. Type: Type "X" at all locations.

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2. Edges: Tapered and featured (rounded or beveled) for prefilling.
- C. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M or ASTM C 1396/C 1396M, 5/8 inch thick, and as follows:
1. Type X at all locations.
 2. Provide water resistant gypsum backing board at all untiled restroom walls and at mechanical room plumbing chases.

2.5 TRIM ACCESSORIES

- A. Accessories for Interior Installation: Provide corner beads, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:
- Material:
1. Formed sheet steel zinc coated by hot-dip process, or rolled zinc.
 2. Shapes as indicated by reference to designations in ASTM C 1047:
 - a. Cornerbead on outside corners, unless otherwise indicated.
 - b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim unless otherwise indicated.
 - c. One-piece control joint formed with V-shaped slot, with removable strip covering slot opening.
- B. Accessory for Curved Edges: Cornerbead formed of metal, plastic, or metal combined with plastic, with either notched or flexible flanges that are bendable to curvature radius.
- C. Reveal Moldings: Reveal moldings are indicated on the Drawings. Where model numbers are not indicated, Architect shall select molding. Provide manufacturer's standard extruded aluminum accessories of sizes indicated, with paintable protective coating. Finish shall be selected by Architect.
1. All trim shall consist of a fin, tapered, grooved and pre-punched for screw attachments and to accept bonding agents. The surface shall be coated with a protective film compatible with plaster, latex, polyurethane epoxy, enamel, etc. Trims are extruded aluminum, alloy 6063, temper T-5 tensile strength 31 KSI.
 2. Available Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries Inc.

2.6 JOINT TREATMENT MATERIALS

- A. General: Provide materials complying with ASTM C 475/C 475M and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.
1. For filling joints and treating fasteners of water-resistant gypsum backing board for application of ceramic tile, use materials recommended by the board manufacturer for this purpose.
- B. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated.
- C. Joint Tape for Cementitious Backer Units: Polymer-coated, open glass-fiber mesh.
- D. Setting-Type Joint Compounds for High Impact Gypsum Board: Factory-packaged, job-mixed, chemical-hardening powder products formulated for prefilling gypsum board joints.

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- E. Setting-Type Joint Compounds for Gypsum Board: Factory-packaged, job-mixed, chemical-hardening powder products formulated for prefilling gypsum board joints.
- F. Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products formulated for both taping and topping compounds.
- G. Joint Compound for Cementitious Backer Unit: Material recommended by cementitious backer unit manufacturer.

2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant (for Exposed or Concealed Joints): Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and having flame-spread and smoke-developed ratings of less than 25 per ASTM E 84.
 - 1. PL Acoustical Sealant; ChemRex, Inc.; Contech Brands.
 - 2. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
 - 3. SHEETROCK Acoustical Sealant; United States Gypsum Co.
- B. Acoustical Sealant (for Concealed Joints): Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound. Acceptable products include the following:
 - 1. BA-98, Pecora Corp.
 - 2. Tremco Acoustical Sealant, Tremco, Inc.
 - 3. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.

2.8 SOUND ATTENUATION MATERIAL

- A. Sound Attenuation Blankets: Unfaced mineral-fiber blanket insulation produced by combining mineral fibers with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing). Provide insulation with maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E 84.
 - 1. Thickness: Minimum 3 1/2" thick or as required to achieve required sound rating.

2.9 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.
- B. Screw Fasteners:
 - 1. Steel drill screws complying with ASTM C 1002 for the following applications:
 - a. Fastening gypsum board to steel members less than 0.03-inch thick.
 - b. Fastening gypsum board to wood members.
 - c. Fastening gypsum board to gypsum board.
 - 2. Steel drill screws complying with ASTM C 954 for fastening gypsum board to steel members from 0.033 to 0.112 inch thick.
 - 3. Corrosion-resistant-coated steel drill screws of size and type recommended by board manufacturer for fastening cementitious backer units.
 - 4. Gypsum board nails: ASTM C 514.

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- E. Frame around existing ductwork where ductwork penetrates wall. Frame and brace to underside of structure with kickers where top of wall meets underside of ductwork. Ductwork shall not be used as supporting member for drywall assembly.

3.4 INSTALLING STEEL FRAMING FOR FURRED CEILINGS

- A. General: At the option of the Installer, any of the following framing methods may be used, unless a specific method is called for by the Drawings.
 - 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 16" o.c., for spans up to 8'-0".
- B. 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.

3.5 INSTALLING STEEL FRAMING FOR WALLS AND PARTITIONS

- A. General: 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 spacings indicated but not less than that required to comply with maximum deflection and minimum loading requirements specified in this Section.
- 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 to avoid deflection transfer to studs. Install studs and top deflection track and/or firestop tracks in accordance with manufacturer's instructions. Provide extended leg ceiling runners.
 - 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. Steel Framing at Door Openings: Frame door openings with two minimum 16 gauge 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.
 - 1. At each door, brace jamb studs (hinge and strike jambs) from door head to underside of structure.
- E. Frame openings other than door openings in same manner as required for door openings. Install framing below sills of openings to match framing required above door heads.

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- F. Clips, Supports, and Brackets: Install clips, supports, brackets, runners, etc. that attach to structural steel or deck receiving fireproofing prior to the application of fireproofing. Repair fireproofing damaged by installation of balance of framing.
- G. Backings for wall mounted accessories and furniture: Provide sheet metal, studs, blocking as necessary and recommended by manufacturer of items being installed for solid anchorage to wall.

3.6 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 reveals, control joints and expansion joints at locations indicated, with space between edges of boards, prepared to receive trim accessories.
 - a. Install control joints between dissimilar wall materials, as shown on drawings, and minimally every 30 feet horizontally or vertically.
 - 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. 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 firestopped as specified in "Section 078413 - Firestopping"

3.7 PARTITION IDENTIFICATION

- A. Stenciling: Stencil the wall rating on each side of wall above the ceiling. Letters shall be minimum 2" high and labeled at 20 foot centers.

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1. Label as “FIRE”, “SMOKE”, and “Number of hours”.
2. Non-rated walls, which extend to deck shall be labeled “NO WALL RATING REQUIRED”.

3.8 SOUND-RATED CONSTRUCTION

- A. Sound Attenuation Blankets: Install sound attenuation blankets where indicated, in coordination with framing erection. Install blankets after framing is complete and piping, conduit, ducts and other penetrating items are complete and tested. At partitions install blankets from open side before second gypsum board face is installed. Cut and fit insulation around penetrating items to fill the area with a continuous insulating barrier. Remove and replace with new material insulation, which becomes displaced, torn, wet and otherwise damaged before it is enclosed.
- B. Acoustical Sealants: Where sound-rated construction is indicated, seal construction at perimeters, control and expansion joints, openings and penetrations with continuous sealant including a bead at both faces of partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
1. Except where fire-rated gypsum board construction is required, provide acoustical sealant as specified in this Section.
 2. Where fire-rated gypsum board construction is required, firestopping sealant shall be provided as specified in “Section 078413 - Firestopping”.

3.9 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 vertically (parallel to supports), unless otherwise indicated, and provide panel lengths that will 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. Wall Tile Substrates: For substrates indicated to receive thin-set ceramic tile and similar rigid applied wall finishes, install cementitious backer units in accordance with “Section 093000 - Ceramic Tile”.
- D. Double-Layer Application: Install gypsum backing board for base layers and special-purpose gypsum wallboard for face layers.
1. On partitions/walls, apply base layers and face layers vertically (parallel to supports) with joints of base layers located over stud or furring member and face layer joints offset at least one stud or furring member from base layer joints. Stagger joints on opposite sides of partitions.
- E. Single-Layer Fastening Methods: Apply gypsum panels to steel framing with screws.
- F. Double-Layer Fastening Methods: Apply base layer of gypsum panels and face layer to base layer as follows:
1. Fasten base layers with screws and gypsum board face layer with adhesive and supplementary fasteners.

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2. Fasten special-purpose board face layers with adhesive only. Assure flush surface alignment of the two types of boards at juncture by building-up adhesive thickness under the thinner board. Install special-purpose boards with snug, flush, butt joints.

3.10 WALL PRIORITY

- A. Wall Intersections: Intersections of walls shall be installed in accordance with a priority of the highest to lowest. The highest priority wall shall continue uninterrupted (IE. gypsum board layers required on each side of wall shall continue through wall intersection) while the lower priority wall shall abut the other wall.

- B. Schedule:

| WALL | PRIORITY |
|----------------------------------|-------------|
| One-hour shaft wall: | 1 (highest) |
| One-hour wall: | 2 |
| Non-rated wall to deck: | 3 |
| Non-rated wall to above ceiling: | 4 (lowest) |

3.11 INSTALLING TRIM 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 reveal trim and other accessories where indicated. Comply with manufacturer's instructions.

- 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 50 feet apart in any direction, 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 changes, including door and window frames. Control joints to be installed at each side of door and window openings.

3.12 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. Prefill 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 reveal trim and coves 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.

1. Level 1: Use for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistive-rated assemblies and sound-rated assemblies.
2. Level 2: Not used.

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3. Level 3: Not used.
 4. Level 4 (Typical Default Finish): Use for surfaces receiving flat or eggshell paints over light textured finish or backed wallcoverings.
 5. Level 5: Not used
- C. Level 1 Finish: Where level 1 gypsum board finish is indicated, apply joint compound specified for embedding coat.
- D. Level 4 Finish: For 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 prefill), and sand between coats and after last coat:
1. Embedding and First Coat: Ready-mixed, drying-type, all-purpose or taping compound.
 2. Fill (Second) Coat: Ready-mixed, drying-type, all-purpose or topping compound.
 3. Finish (Third) Coat: Ready-mixed, drying-type, all-purpose or topping compound.
- E. Level 5 Finish: Where level 5 gypsum board finish is required, provide finish specified for level 4 plus a thin, uniform skim coat of joint compound over entire surface. Use joint compound specified for the finish (third coat). Produce surfaces free of tool marks and ridges ready for decoration of type indicated.
- F. Base for Ceramic Tile: Finish cementitious backer units to comply with unit manufacturer's directions.
- G. Control Joint Finishing: At all control joints and at all joints between high impact wall panels use manufacturer's recommended setting compound manufacturers recommended tape.
- H. Existing Surfaces: Repair existing surfaces to provide uniform finished surfaces, which are not evident as patches. Include surfaces, which are defective, damaged or defaced as a result of selective removal, previous occupancy, or deficient workmanship. Skim coat overall if necessary to repair defects and provide uniform smooth surface, using adhesive compound recommended by the compound manufacturer. At repairs of limited extent, feather out compound over existing smooth surfaces to avoid obvious patched appearance.

3.13 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.

END OF SECTION 09 29 00

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Porcelain tile.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples:
 - 1. Each type and composition of tile and for each color and finish required.
 - 2. Assembled samples, with grouted joints, for each type and composition of tile and for each color and finish required.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of each type of wall tile installation.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 TILE PRODUCTS

- A. ANSI Ceramic Tile Standard: Provide Standard grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. Tile Type PT-1 & PT-2: Porcelain floor and wall tile (Same Tile / Differing Color Selections).
 - 1. Subject to compliance with requirements, provide products by one of the following:

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- a. Daltile – Reminiscent
 - b. Concept Surfaces – Bottega
 - c. Landmark Ceramics – Made.in (Basis of Design)
 2. Module Size: 12" x 24".
 3. Face: Pattern of design indicated, with manufacturer's standard edges.
 4. Tile Color and Pattern: Colorbody / Through Body Color. To be selected by Architect from Manufacturers Full Range
 5. Grout Color: To be selected by Architect from Manufacturers Standard Range.
 6. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Wainscot Cap / Bullnose: See drawings.
 - b. Cove Base
 - c. Corner Trims
 7. Wet Areas (≥ .42 Edge)
- C. Tile Type PT-3: Mosaic Tile (Showers)
1. Subject to compliance with requirements, provide products by one of the following (Style Match Selections for PT1-PT2):
 - a. Daltile – Reminiscent
 - b. Concept Surfaces – Bottega
 - c. Landmark Ceramics – Made.in (Basis of Design)
 2. Module Size: 2" x 2" Mosaic
 3. Face: Pattern of design indicated, with manufacturer's standard edges.
 4. Tile Color and Pattern: Colorbody / Through Body Color. To be selected by Architect from Manufacturers Full Range
 5. Grout Color: To be selected by Architect from Manufacturers Standard Range.
 6. Wet Areas (≥ .42 Edge)
- D. Tile Type PT-4: Wall/Accent Tile
1. Subject to compliance with requirements, provide products by one of the following:
 - a. Concept Surfaces – Palotia (Basis of Design)
 - b. Or approved equal
 2. Module Size: 2" x 10".
 3. Face: Raised Style, to be determined by Architect from Manufacturers Full Range
 4. Tile Color and Pattern: Colorbody / Through Body Color. To be selected by Architect from Manufacturers Full Range
 5. Grout Color: To be selected by Architect from Manufacturers Standard Range.
- ### 2.2 TILE BACKING PANELS
- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325.
 1. As provided in Section 092900 – Gypsum Board.
- ### 2.3 SETTING MATERIALS
- A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. Bostik, Inc.
 - b. C-Cure.
 - c. Laticrete International, Inc.
 - d. MAPEI Corporation.
2. Prepackaged, dry-mortar mix to which only water must be added.
 3. Prepackaged, dry-mortar mix combined with liquid-latex additive.
 4. For wall applications, provide non-sagging mortar.

2.4 GROUT MATERIALS

A. Polymer-Modified Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. TEC "Power Grout" - COLOR SELECTED BY ARCHITECT
2. Polymer Type: Dry, re-dispersible form, prepackaged with other dry ingredients.
3. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.

2.5 ELASTOMERIC SEALANTS

A. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; Dow Corning 786.
 - b. GE Silicones, a division of GE Specialty Materials; Sanitary 1700.
 - c. Laticrete International, Inc.; Latasil Tile & Stone Sealant.

PART 3 - EXECUTION

3.1 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.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowel able leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at Project site before installing.

- C. 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.

3.3 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 (200 by 200 mm) or larger.
 - c. Tile floors composed of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete 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 penetrations 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.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Wall Tile: 1/16 inch (1.6 mm)
- G. Lay out tile wainscots to dimensions and pattern indicated in drawings.

END OF SECTION 093000

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SECTION 09 30 50 - TILE SETTING MATERIALS AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Edge-protection and transition profiles for floors.

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 06 10 00 - Rough Carpentry.
- C. Section 07 92 00 - Joint Sealants.
- D. Section 09 30 00 - Tiling.

1.3 REFERENCES

- A. CSA B79-08: Floor, Area, and Shower Drains, and Cleanouts for Residential Construction.
- B. IAPMO IGC 195: Interim Guide Criteria for Floor Drain with Integrated Bonding Flange.
- C. Tile Council of North America (TCNA) Handbook for Ceramic Tile Installation.
- D. Terrazzo, Tile and Marble Association of Canada (TTMAC) Specification Guide 09300 Tile Installation Manual.
- E. American National Standard Specifications for the installation of ceramic tile A108 / A118 / A136.1.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- 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. Installation methods.
- C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and finish.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Warranty document showing duration and scope to be submitted with product submittals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years' experience.
- B. Source Limitations for Setting Materials and Accessories: Obtain product of a uniform quality for each application condition from a single manufacturer.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

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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.
- D. Preinstallation Conference: Conduct conference at the Project site.
1. Convene one week prior to commencing work of this section.
 2. Require attendance of installation material manufacturer, tile supplier, tile installer and installers of related work. Review installation procedures and coordination required with related work.
 3. Meeting agenda includes but is not limited to:
 - a. Surface preparation.
 - b. Tile and installation material compatibility.
 - c. Manufacturer and installer warranty duration and scope covered by warranty.
 - d. Edge protection, transition, and pre-fabricated movement joint profiles.
 - e. Waterproofing techniques.
 - f. Crack isolation techniques.
- 1.6 DELIVERY, 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.
- 1.7 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.
- 1.8 WARRANTY
- A. Provide sample warranty during submittal process.
 - B. Acknowledge warranty duration and scope covered by warranty.
 - C. Coordinate Work with other operations and installation of floor finish materials to avoid damage to installed materials.
 - D. Obtain products of a uniform quality for each premanufactured tile profile, and mortar and waterproofing and uncoupling membrane from a single manufacturer, to maintain the installation system and provide multi-product warranty from selected manufacturer.
- 1.9 COORDINATION
- A. Coordinate Work with other operations and installation of floor finish materials to avoid damage to installed materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Schluter Systems L.P., which is located at: 194 Pleasant Ridge Road.; Plattsburgh, NY 12901-5841; ASD Toll Free Tel: 800-472-4588; Fax: 800-477-9783; Email:specassist@schluter.com; Web:www.schluter.com/schluter-us/en_US/.
- B. Or Approved Equal.

TILE SETTING MATERIALS AND ACCESSORIES

2.2 EDGE-PROTECTION AND TRANSITION PROFILES FOR FLOORS

- A. Schluter-SCHIENE: L-shaped profile with 1/8 inch (3 mm) wide visible surface integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 1. Anchoring Leg: Straight anchoring leg.
 - 2. Profile Height: As required to coordinate with tile selection and setting system.
 - 3. Material and Finish:
 - a. AE: Satin Anodized Aluminum.
- B. Schluter-RENO-T: T-shaped profile with 1/16 inch (1 mm) thick beveled exposed surface and 11/32 inch (9 mm) tall integrated vertical anchoring leg.
 - 1. Profile Width: As required.
 - 2. Material and Finish:
 - a. AE: Satin Anodized Aluminum.
- C. Schluter-RENO-U: Profile with sloped exposed surface, 5/32 inch (4 mm) tall leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 1. Profile Height: As required to coordinate with tile selection and setting system.
 - 2. Material and Finish:
 - a. AE: Satin Anodized Aluminum.
- D. Schluter-RENO-RAMP: Anodized aluminum profile with textured, sloped exposed surface, tapered leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 1. Material and Finish: AE: Satin Anodized Aluminum.
 - 2. Ramp Length: As required.
 - a. Profile Height: As required.

PART 3 EXECUTION

3.1 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.

3.2 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.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 09 50 00 - ACOUSTICAL CEILING TILE SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes

1. Acoustical ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

B. Related Sections

1. Section 09 51 00 - Acoustical Ceilings
2. Section 09 51 13 - Acoustical Fabric-Faced Panel Ceilings
3. Section 09 53 00 - Acoustical Ceiling Suspension Assemblies
4. Section 09 20 00 - Plaster and Gypsum Board
5. Section 01 81 13 - Sustainable Design Requirements
6. Section 01 81 19 - Indoor Air Quality Requirements
7. Section 02 42 00 - Removal and Salvage of Construction Materials
8. Divisions 23 - HVAC Air Distribution
9. Division 26 - Electrical

C. Alternates

1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.

2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.3 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

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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 D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
8. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
9. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Material
 - A. Armstrong Fire Guard Products
10. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
11. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems
12. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
13. ASTM E 1264 Classification for Acoustical Ceiling Products

B. International Building Code

C. ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality

D. NFPA 70 National Electrical Code

E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components

G. International Code Council-Evaluation Services Report - Seismic Engineer Report

1. ESR 1308 - Armstrong Suspension Systems

H. International Association of Plumbing and Mechanical Officials - Seismic Engineer Report

1. 0244 - Armstrong Single Span Suspension System

I. California Department of Public Health CDPH/EHLB Emission Standard Method Version 1.1 2010

J. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

K. International Well Building Standard

L. Mindful Materials

M. Living Building Challenge

N. U.S. Department of Agriculture BioPreferred program (USDA BioPreferred).

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1.4 SYSTEM DESCRIPTION

Continuous/Wall-to-Wall

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.

B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with, or supported by the ceilings.

D. Acoustical Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.

a. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.6 SUSTAINABLE MATERIALS

Transparency: Manufacturers will be given preference when they provide documentation to support sustainable requirements for the following: Material ingredient transparency, Removal of Red List Ingredients per LBCV3, Life Cycle impact information, Low-Emitting Materials, and Clean Air performance.

1. Health Product Declaration. The end use product has a published, complete Health Product Declaration with disclosure at a minimum of 1000ppm of known hazards in compliance with the Health Product Declaration open Standard.

2. Declare Label. The end use product has a published Declare label by the International Living Future Institute with disclosure of 100 ppm with a designation of Red List Free or Compliant (less than 1% proprietary ingredients).

3. Low Emitting products with VOC emissions data. Preference will also be given to manufacturers that can provide emissions data showing their products meet CDHP Standard Method v1.1 (Section 01350).

4. Life cycle analysis. Products that have communicated lifecycle data through Environmental Product Declarations (EPDs) will be preferred.

5. End of Life Programs/Recycling: Where applicable, manufacturers that provide the option for recycling of their products into new products at end-of-life through take-back programs will be preferred.

6. Products meeting LEED V4 requirements including:

Storage & Collection of Recyclables

Construction and Demolition Waste Management Planning

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Building Life-Cycle Impact Reduction

Building Product Disclosure and Optimization Environmental Product Declarations

Building Product Disclosure and Optimization Sourcing of Raw Materials

Building Product Disclosure and Optimization Material Ingredients

Construction and Demolition Waste Management

1.7 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

1. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

2. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.

3. Fire Resistance: As follows tested per ASTM E119 and listed in the appropriate floor or roof design in the Underwriters Laboratories Fire Resistance Directory

B. Acoustical Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

C. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.9 PROJECT CONDITIONS

A. Space Enclosure:

Standard Ceilings: Do not install interior ceilings until space is enclosed and weatherproof; wet work in place is completed and nominally dry; work above ceilings is complete; and ambient conditions of temperature and humidity are continuously maintained at values near those intended for final occupancy. Building areas to receive ceilings shall be free of construction dust and debris.

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HumiGuard Plus Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Products with HumiGuard Plus performance and hot dipped galvanized steel, aluminum or stainless steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

HumiGuard Max Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Ceilings with HumiGuard Max performance can be installed in conditions up to 120°F (49°C) and maximum humidity exposure including outdoor applications, and other standing water applications, so long as they are installed with either SS Prelude Plus, AL Prelude Plus, or Prelude Plus Fire Guard XL suspension systems. Products with Humiguard Max performance can be installed in exterior applications, where standing water is present, or where moisture will come in direct contact with the ceiling. Only Ceramaguard with AL Prelude Plus suspension system can be installed over swimming pools.

1.10 ALTERNATE CONSTRUCTION WASTE DISPOSAL

A. Ceiling material being reclaimed must be kept dry and free from debris.

B. Contact the Armstrong Recycle Center a consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant will provide assistance to facilitate the recycling of the ceiling.

C. Recycling may qualify for LEED Credits:

a. LEED 2009 - Category 4: Material and Resources (MR)

i. Credit MRc2: Construction Waste Management

b. LEEDv4 - MRp2 - Construction Waste Management Planning Qualifies as a material stream (non-structural) targeted for diversion. Ceilings will be source-separated and diverted through the Armstrong Ceiling Recycling Program.

c. LEEDv4-MRc5 -

i. Option 1: Divert ceilings to qualify for one of the 3 material streams (50%)

ii. Option 2: Divert ceilings to qualify for one of the 4 material streams (75%)

1.11 WARRANTY

A. Acoustical 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 the following:

1. Acoustical Panels: Sagging and warping

2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Acoustical panels: Ten (10) years from date of substantial completion

2. Suspension: Ten (10) years from date of substantial completion

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3. Ceiling System: Thirty (30) years from date of substantial completion

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.

1.12 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. Acoustical 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

2.1 MANUFACTURERS

A. Ceiling Panels:

1. Armstrong World Industries, Inc. – Basis of Design
717.397.0611 / 877.ARMSTRONG
www.armstrongworldindustries.com
Armstrong Ceilings Manufacturer Representative: Catherine Nipper
cmnipper@armstrongceilings.com
2. USG
800.950.3839
www.usg.com
3. Hunter Douglas Architectural
800.727.8953
www.hunterdouglasarchitectural.com
4. Or prior approved equal.

B. Suspension Systems:

1. Armstrong World Industries, Inc. – Basis of Design
717.397.0611 / 877.ARMSTRONG
www.armstrongworldindustries.com
Armstrong Ceilings Manufacturer Representative: Catherine Nipper
cmnipper@armstrongceilings.com
2. USG
800.950.3839
www.usg.com

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3. Hunter Douglas Architectural
800.727.8953
www.hunterdouglasarchitectural.com
4. Or prior approved equal.

C. Perimeter Systems:

1. Armstrong World Industries, Inc. – Basis of Design
717.397.0611 / 877.ARMSTRONG
www.armstrongworldindustries.com
Armstrong Ceilings Manufacturer Representative: Catherine Nipper
cmnipper@armstrongceilings.com
2. USG
800.950.3839
www.usg.com
3. Hunter Douglas Architectural
800.727.8953
www.hunterdouglasarchitectural.com
4. Or prior approved equal.

2.2.1 ACOUSTICAL CEILING UNITS

1. Acoustical Panels Type ACT-1
 - a. Surface Texture: Fine
 - b. Composition: Mineral Fiber
 - c. Color: White
 - d. Size: 24" x 24"
 - e. Edge Profile: Beveled Tegular 9/16" for interface with SUPRAFINE XL 9/16" Exposed Tee grid.
 - f. Noise Reduction Coefficient(NRC): 0.75; ASTM C 423; Classified with UL label on product carton
 - g. Ceiling Attenuation Class (CAC) : 35; ASTM C 1414; Classified with UL label on product carton
 - h. Sabin: N/A
 - i. Articulation Class (AC):
 - j. Flame Spread: ASTM E 1264; Class A (UL)
 - k. Light Reflectance (LR) White Panel: ASTM E 1477; 0.88
 - l. Dimensional Stability: HUMIGUARD Plus
 - m. Recycle Content: Post-Consumer - 0% - 1% Pre-Consumer - 74% - 75%
 - n. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
 - o. Life Cycle Assessment: Third Party Certified Environment Product Declaration (EPD)
 - p. Acceptable Product: ULTIMA Field Panels, Item: 1912 - Armstrong World Industries
2. Acoustical Panels Type ACT-2
 - a. Surface Texture: Fine

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- b. Composition: Mineral Fiber , Anti-Bacterial/Mold Resistant/Mildew Resistant
- c. Color: White
- d. Size: 24" x 24"
- e. Edge Profile: Beveled Tegular 15/16" for interface with PRELUDE Plus XL FIRE GUARD 15/16" Exposed Tee grid.
- f. Noise Reduction Coefficient(NRC): 0.70; ASTM C 423; Classified with UL label on product carton
- g. Ceiling Attenuation Class (CAC) : 38; ASTM C 1414; Classified with UL label on product carton
- h. Sabin: N/A
- i. Articulation Class (AC):
- j. Flame Spread: ASTM E 1264; Class A (UL)
- k. Light Reflectance (LR) White Panel: ASTM E 1477; 0.86
- l. Dimensional Stability: HUMIGUARD Plus
- m. Recycle Content: Post-Consumer - 0% Pre-Consumer - 76%
- n. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
- o. Life Cycle Assessment: Third Party Certified Environment Product Declaration (EPD)
- p. Acceptable Product: ULTIMA HEALTH ZONE, Item: 1937 - Armstrong World Industries

3. Acoustical Panels Type ACT-3 (ACT-3A/ACT-3B)

- a. Surface Texture: Fine
- b. Composition: Fiberglass
- c. Color: White
- d. Size: 24" x 96" (ACT-3A), 6" x 96" (ACT-3B)
- e. Edge Profile: Square Tegular 9/16" for interface with SUPRAFINE XL 9/16" Exposed Tee grid.
- f. Noise Reduction Coefficient(NRC): 0.70; ASTM C 423; Classified with UL label on product carton
- g. Ceiling Attenuation Class (CAC) : 38; ASTM C 1414; Classified with UL label on product carton
- h. Sabin: N/A
- i. Articulation Class (AC):
- j. Flame Spread: ASTM E 1264; Class A (UL)
- k. Light Reflectance (LR) White Panel: ASTM E 1477; 0.88
- l. Dimensional Stability: HUMIGUARD Plus
- m. Recycle Content: Post-Consumer - 12% Pre-Consumer - 59%
- n. Acceptable Product: OPTIMA Field Panels, item 3262 (ACT-3) with Optima TechZone; Item 1409 (ACT-3B) – Armstrong World Industries

2.3.1 METAL SUSPENSION SYSTEMS

1. Suspension Systems Type ACT-1:

A. Components:

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.

ACOUSTICAL CEILING TILE SYSTEMS

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- a. Structural Classification: ASTM C 635 Intermediate Duty
- b. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
- c. Sustainability: Environmental Product Declaration (EPD), Health Product Declaration (HPD)
- d. Acceptable Product: SUPRAFINE XL 9/16" Exposed Tee - Armstrong World Industries
- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire for Hangers and Ties: 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. Edge Moldings and Trim:
 - a. 7804 - 12ft Hemmed Angle Molding
- E. Accessories:

2. Suspension Systems Type ACT-2:

A. Components:

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.

- e. Structural Classification: ASTM C 635 Intermediate Duty
- f. Color: White Aluminum Cap
- g. Sustainability: Environmental Product Declaration (EPD), Health Product Declaration (HPD)
- h. Acceptable Product: PRELUDE Plus XL White Aluminum Cap 15/16" Exposed Tee - Armstrong World Industries
- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire for Hangers and Ties: 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. Edge Moldings and Trim:
 - a. 7800WA – 12ft. Wall Molding

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E. Accessories:

3. Suspension Systems Type ACT-3 (ACT-3A / ACT-3B):

A. Components:

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 Intermediate Duty
 - b. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
 - c. Sustainability: Environmental Product Declaration (EPD), Health Product Declaration (HPD)
 - d. Acceptable Product: SUPRAFINE XL 9/16" Exposed Tee - Armstrong World Industries
- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire for Hangers and Ties: 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. Edge Moldings and Trim:
- a. 7804 – 12ft Hemmed Angle Molding
- E. Accessories:
- a. 1. 441 - Optima Border Clip
 - b. 523 - Mid-point Clip

2.4.1 ALUMINUM CUSTOM TRIM - EXTRUDED

Product/Manufacturer: Axiom Trim Channel: 6in Axiom Classic Straight - Armstrong World Industries, Incorporated

A. Commercial quality extruded aluminum alloy 6063 trim channel, factory finished in baked polyester paint. Commercial quality galvanized steel unfinished T-bar connection clips; galvanized steel splice plates.

1. Color: White
2. Size: 120" X 6"
3. Recycle Content: Post-Consumer - 10% Pre-Consumer - 35%

ACOUSTICAL CEILING TILE SYSTEMS

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4. Acceptable Product: AXIOM Classic, 6in Axiom Classic Straight -Armstrong World Industries

B. Axiom Trim Channel:

6in Axiom Classic Straight

C. Axiom Outside Corner Posts (Straight Only):

1. 6in Axiom Classic Outside Corner Post

D. Axiom Inside Corners (Straight Only):

1. 6" Axiom Classic Inside Corner Post

E. Axiom Accessories:

None

PART 3 - EXECUTION

3.1 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, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.2 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. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.3 INSTALLATION

A. Follow manufacturer installation instructions.

B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.

C. Suspend main beam from overhead construction with hanger wires spaced 4'-0" on center along the length of the main runner. Install hanger wires plumb and straight.

D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

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E. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

C. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876, select option #1 then #8 to review with a consultant the condition and location of building where the ceilings will be removed. The consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant will provide assistance to facilitate the recycle of the ceiling.

SECTION 09 51 00 – ACOUSTICAL CEILING ELEMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes

1. Acoustical ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

B. Related Sections

1. Section 09 51 00 - Acoustical Ceilings
2. Section 09 51 13 - Acoustical Fabric-Faced Panel Ceilings
3. Section 09 53 00 - Acoustical Ceiling Suspension Assemblies
4. Section 09 20 00 - Plaster and Gypsum Board
5. Section 01 81 13 - Sustainable Design Requirements
6. Section 01 81 19 - Indoor Air Quality Requirements
7. Section 02 42 00 - Removal and Salvage of Construction Materials
8. Divisions 23 - HVAC Air Distribution
9. Division 26 - Electrical

C. Alternates

1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.

2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.3 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

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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 D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
8. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
9. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Material
 - A. Armstrong Fire Guard Products
10. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
11. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems
12. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
13. ASTM E 1264 Classification for Acoustical Ceiling Products

B. International Building Code

C. ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality

D. NFPA 70 National Electrical Code

E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components

G. International Code Council-Evaluation Services Report - Seismic Engineer Report

1. ESR 1308 - Armstrong Suspension Systems

H. International Association of Plumbing and Mechanical Officials - Seismic Engineer Report

1. 0244 - Armstrong Single Span Suspension System

I. California Department of Public Health CDPH/EHLB Emission Standard Method Version 1.1 2010

J. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

K. International Well Building Standard

L. Mindful Materials

M. Living Building Challenge

N. U.S. Department of Agriculture BioPreferred program (USDA BioPreferred).

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1.4 SYSTEM DESCRIPTION

Acoustical Clouds/ Canopies, Acoustical Blades/ Baffles, Architectural Elements

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.

B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with, or supported by the ceilings.

D. Acoustical Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.

a. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.6 SUSTAINABLE MATERIALS

Transparency: Manufacturers will be given preference when they provide documentation to support sustainable requirements for the following: Material ingredient transparency, Removal of Red List Ingredients per LBCV3, Life Cycle impact information, Low-Emitting Materials, and Clean Air performance.

1. Health Product Declaration. The end use product has a published, complete Health Product Declaration with disclosure at a minimum of 1000ppm of known hazards in compliance with the Health Product Declaration open Standard.

2. Declare Label. The end use product has a published Declare label by the International Living Future Institute with disclosure of 100 ppm with a designation of Red List Free or Compliant (less than 1% proprietary ingredients).

3. Low Emitting products with VOC emissions data. Preference will also be given to manufacturers that can provide emissions data showing their products meet CDHP Standard Method v1.1 (Section 01350).

4. Life cycle analysis. Products that have communicated lifecycle data through Environmental Product Declarations (EPDs) will be preferred.

5. End of Life Programs/Recycling: Where applicable, manufacturers that provide the option for recycling of their products into new products at end-of-life through take-back programs will be preferred.

6. Products meeting LEED V4 requirements including:

Storage & Collection of Recyclables

Construction and Demolition Waste Management Planning

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Building Life-Cycle Impact Reduction

Building Product Disclosure and Optimization Environmental Product Declarations

Building Product Disclosure and Optimization Sourcing of Raw Materials

Building Product Disclosure and Optimization Material Ingredients

Construction and Demolition Waste Management

1.7 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

1. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

2. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.

3. Fire Resistance: As follows tested per ASTM E119 and listed in the appropriate floor or roof design in the Underwriters Laboratories Fire Resistance Directory

B. Acoustical Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

C. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.9 PROJECT CONDITIONS

A. Space Enclosure:

Standard Ceilings: Do not install interior ceilings until space is enclosed and weatherproof; wet work in place is completed and nominally dry; work above ceilings is complete; and ambient conditions of temperature and humidity are continuously maintained at values near those intended for final occupancy. Building areas to receive ceilings shall be free of construction dust and debris.

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HumiGuard Plus Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Products with HumiGuard Plus performance and hot dipped galvanized steel, aluminum or stainless steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

HumiGuard Max Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Ceilings with HumiGuard Max performance can be installed in conditions up to 120°F (49°C) and maximum humidity exposure including outdoor applications, and other standing water applications, so long as they are installed with either SS Prelude Plus, AL Prelude Plus, or Prelude Plus Fire Guard XL suspension systems. Products with Humiguard Max performance can be installed in exterior applications, where standing water is present, or where moisture will come in direct contact with the ceiling. Only Ceramaguard with AL Prelude Plus suspension system can be installed over swimming pools.

1.10 ALTERNATE CONSTRUCTION WASTE DISPOSAL

A. Ceiling material being reclaimed must be kept dry and free from debris.

B. Contact the Armstrong Recycle Center a consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant will provide assistance to facilitate the recycling of the ceiling.

C. Recycling may qualify for LEED Credits:

a. LEED 2009 - Category 4: Material and Resources (MR)

i. Credit MRc2: Construction Waste Management

b. LEEDv4 - MRp2 - Construction Waste Management Planning Qualifies as a material stream (non-structural) targeted for diversion. Ceilings will be source-separated and diverted through the Armstrong Ceiling Recycling Program.

c. LEEDv4-MRc5 -

i. Option 1: Divert ceilings to qualify for one of the 3 material streams (50%)

ii. Option 2: Divert ceilings to qualify for one of the 4 material streams (75%)

1.11 WARRANTY

A. Acoustical 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 the following:

1. Acoustical Panels: Sagging and warping

2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Acoustical panels: Ten (10) years from date of substantial completion

2. Suspension: Ten (10) years from date of substantial completion

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3. Ceiling System: Thirty (30) years from date of substantial completion

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.

1.12 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. Acoustical 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

2.1 MANUFACTURERS

1. Armstrong World Industries, Inc. / Turf Design, Inc – Basis of Design
717.397.0611 / 877.ARMSTRONG
www.armstrongworldindustries.com / turf.design
Armstrong Ceilings Manufacturer Representative: Catherine Nipper
cmnipper@armstrongceilings.com
2. USG
800.950.3839
www.usg.com
3. Hunter Douglas Architectural
800.727.8953
www.hunterdouglasarchitectural.com
4. Or prior approved equal.

2.2.1 ACOUSTICAL CEILING UNITS

A. Acoustic Ceiling Cloud Type AC-1

1. Surface Texture: Fine
2. Composition: Fiberglass
3. Color: Lagoon (Tentative Selection); Final selections to be confirmed from manufacturers full range
4. Size: 3'-10" Diameter
5. Edge Profile: Square, finished edge
6. Noise Reduction Coefficient(NRC):

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7. Ceiling Attenuation Class (CAC) :
8. Sabin: Up to 1.18
9. Articulation Class (AC):
10. Flame Spread: ASTM E 1264; Class A (UL)
11. Light Reflectance (LR) White Panel: ASTM E 1477; 0.90
12. Dimensional Stability: Standard
13. Recycle Content: Post-Consumer - 12% Pre-Consumer - 59%
14. Acceptable Product: SOUNDSCAPES Shapes, Item: 5443 - Armstrong World Industries

B. Acoustic Ceiling Baffle Type AB-1, AB-2, AB-3

1. Surface Texture:
2. Composition: Polyester Felt (PET); 9mm thickness
3. Color: To be selected from manufacturers full range
4. Size: Baffle Thickness: 2.25" / Baffle Depth: 8.68" / Lengths: 4'-0"L, 8'-0"L
5. Edge Profile: Square, Pre-finished edge
6. Noise Reduction Coefficient (NRC): 8.75" Depth with 12" O.C Spacing - NRC 1.55
7. Acoustics: ASTM C 423-17; Type J
8. Fire Rating: ASTM E 84 – Class A
9. Dimensional Stability:
10. Recycle Content: Post-Consumer - 0% Pre-Consumer - 60%
11. Acceptable Product: SLAB, Item: 5443 – Turf Design, Inc (Armstrong World Industries)

PART 3 - EXECUTION

3.1 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, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.2 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. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

ACOUSTICAL CEILING ELEMENTS

3.3 INSTALLATION

- A. Follow manufacturer installation instructions.
- B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.
- C. Suspend main beam from overhead construction with hanger wires spaced 4-0 on center along the length of the main runner. Install hanger wires plumb and straight.
- D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.
- E. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.
- F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.4 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.
- B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.
- C. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876, select option #1 then #8 to review with a consultant the condition and location of building where the ceilings will be removed. The consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant will provide assistance to facilitate the recycle of the ceiling.

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SECTION 09 51 33 - EXTERIOR METAL LINEAR CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes:

1. Metal Linear ceiling panels.
2. Grid suspension system, and Standard Carrier
3. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories.

B. Related Sections:

1. Section 09 51 13 - Acoustical Panel Ceilings
2. Section 09 29 00 - Gypsum Board Assemblies
3. Divisions 23 - HVAC
4. Division 26 Sections - Electrical Work

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
2. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
3. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
4. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
5. UL580 Tests for Uplift Resistance of Roof Assemblies

B. International Code Council Evaluation Services

AC156- Acceptance Criteria for Seismic Qualification Testing of Non-Structural Components

1.4 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 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

D. Shop Drawings: Layout and details of ceilings. Show locations of items which 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.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility (Both Interior and Exterior Linear Ceilings): 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 per ASTM E 84 and complying with ASTM E 1264 for Class A products.

a. Flame Spread: 25 or less

b. Smoke Developed: 50 or less

C. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

D. Seismic Performance: System Seismic performance verified through full scale testing in accordance with ICC-ES-AC156 Acceptance Criteria for seismic Qualification Testing of Non Structural Components.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

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B. Handle ceiling units carefully to avoid damaging units in any way.

1.7 PROJECT CONDITIONS

A. MetalWorks Linear, Items #5490M1 (nonperforated) and #5491M1 (nonperforated) are recommended for exterior applications except in geographical areas with high concentrations of acid rain. They are not recommended for use in indoor pool applications.

1.8 WARRANTY

A. Exterior Applications Suspension Systems installed together as a system for exterior use are warranted to be free from defects in materials or factory workmanship, and against the occurrence of 50% red dust as defined by ASTM B 117 test procedures for one (1) year from the date of installation.

B. Finish Warranty: Provide 5 year finish warranty.

1.9 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 quality 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.

2.1 MANUFACTURERS

A. Metal Ceiling Panels:

1. Armstrong World Industries, Inc. – Basis of Design
717.397.0611 / 877.ARMSTRONG
www.armstrongworldindustries.com
Armstrong Ceilings Manufacturer Representative: Catherine Nipper
cmnipper@armstrongceilings.com
2. USG
800.950.3839
www.usg.com
3. Hunter Douglas Architectural
800.727.8953
www.hunterdouglasarchitectural.com
4. Or prior approved equal.

B. Suspension Systems:

1. Armstrong World Industries, Inc. – Basis of Design
717.397.0611 / 877.ARMSTRONG
www.armstrongworldindustries.com
Armstrong Ceilings Manufacturer Representative: Catherine Nipper
cmnipper@armstrongceilings.com
2. USG
800.950.3839
www.usg.com
3. Hunter Douglas Architectural

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800.727.8953

www.hunterdouglasarchitectural.com

4. Or prior approved equal.

C. Aluminum Custom Trims:

1. Armstrong World Industries, Inc. – Basis of Design
717.397.0611 / 877.ARMSTRONG
www.armstrongworldindustries.com
Armstrong Ceilings Manufacturer Representative: Catherine Nipper
cmnipper@armstrongceilings.com
2. USG
800.950.3839
www.usg.com
3. Hunter Douglas Architectural
800.727.8953
www.hunterdouglasarchitectural.com
4. Or prior approved equal.

2.2. METAL CEILINGS PANELS

A. Acoustical Panels Type ACP-3, ACP-4

1. Acoustical Panels Type ACP-3 (Exterior):
 - a. Surface Texture: Smooth
 - b. Composition: Electrogalvanized Steel 0.028"
 - c. Color: Effects Color For Exterior Use - To Be Determined from manufacturer's full range of standard wood finishes
 - d. Size: 13IN x 96IN
 - e. Edge Profile: Linear
 - f. Perforation Option: Unperforated M1
 - g. Noise Reduction Coefficient(NRC): 0.70
 - h. Ceiling Attenuation Class (CAC) : N/A
 - i. Sabin: N/A
 - j. Articulation Class (AC): N/A
 - k. Flame Spread: ASTM E 1264; Class A (FM)
 - l. Light Reflectance: N/A
 - m. Dimensional Stability: Standard
 - n. Acceptable Product: Armstrong MetalWorks Linear - Synchro, (8223W13M1) as manufactured by Armstrong World Industries NOTE: Contact Armstrong for installation guidance and training on the new Metalworks Linear Synchro system.
2. Acoustical Panels Type ACP-4 (Exterior):
 - a. Surface Texture: Smooth
 - b. Composition: Electrogalvanized Steel 0.028"
 - c. Color: Metal Color For Exterior Use - To Be Determined from manufacturer's full range of standard non-wood finishes
 - d. Size: 13IN x 96IN
 - e. Edge Profile: Linear

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- f. Perforation Option: Unperforated M1
- g. Noise Reduction Coefficient(NRC): 0.70
- h. Ceiling Attenuation Class (CAC) : N/A
- i. Sabin: N/A

PART 3 - EXECUTION

3.1 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, unless expressly permitted by manufacturer's printed recommendations.

3.2 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.

3.3 INSTALLATION

A. Install suspension system and panels in accordance with UL580, installation instructions, LA297437 for exterior applications, ASTM C636, and in compliance with the authorities having jurisdiction.

3.4 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 – 09 51 33

SECTION 09 54 23 - LINEAR METAL CEILINGS - INTERIOR

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes:

1. Acoustical Metal ceiling panels.
2. Suspension system.
3. Wire hangers, carrier channels, wall angle moldings and accessories.
4. Perimeter Trim

B. Related Sections:

1. Section 09 51 23 – Acoustical Panel Ceilings
2. Section 09 51 33 – Exterior Linear Metal Ceilings
3. Section 09 29 00 – Gypsum Board Assemblies
4. Division 23 Heating, Ventilating, and Air Conditioning
5. Division 26 Electrical Work

C. Alternates

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
2. ASTM B 209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
3. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
4. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.

B. International Code Council Evaluation Service

1. AC156 - Acceptance Criteria for Seismic Qualification Testing of Non-structural Components

1.4 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. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility (For both Interior and Exterior Linear Ceilings) Provide Connections metal ceiling and suspension components

produced by a single manufacturer with resources adequate to deliver a product of consistent quality in terms of appearance and physical properties for all project scopes and scales without risk of delay or interruption.

B. Fire Performance Characteristics: Identify ceiling components with appropriate applicable, testing, including:

1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with Class A fire performance as follows:

- a. Flame Spread: 25 or less
- b. Smoke Developed: 50 or less

C. Seismic Performance: System seismic performance verified through full-scale testing in accordance with ICC-ES – AC-156 Acceptance Criteria for Seismic Qualification Testing of Non-Structural components.

D. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver system components in manufacturer's original, unopened packages clearly labeled with the following information: item number and quantity, manufacturer's name and address, client name and address and site address.

B. Store components in a fully enclosed dry space where they will be protected against damage from moisture, direct sunlight, surface contamination and other construction activities.

C. Exercise care in handling components to prevent damage to the surfaces and edges and prevent distortion or other physical damage.

1.7 PROJECT CONDITIONS

A. Space Enclosure:

Building areas to receive ceilings shall be free of construction dust and debris. Products may be installed where temperatures are between 32°F (0°C) and 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Such installations shall not be exposed to abnormal conditions, namely: chemical fumes, presence of standing water, or contact with moisture, as could result from condensations or building leaks. The Connections system only may be used in exterior applications.

1.8 WARRANTY

A. Ceiling System: 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. Rust and manufacturing defects.

B. Warranty Period:

1. Ceiling System: One (1) year from date of substantial completion.
2. Grid: Ten (10) years from date of substantial completion

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.

1.9 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 2.0 percent of amount installed.
2. Suspension System Components: Furnish quantity of each exposed suspension component equal to 1.0 percent of amount installed.

B. Deliver extra stock to Owner's representative.

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PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Metal Ceiling Panels:

1. Armstrong World Industries, Inc. – Basis of Design
717.397.0611 / 877.ARMSTRONG
www.armstrongworldindustries.com
Armstrong Ceilings Manufacturer Representative: Catherine Nipper
cmnipper@armstrongceilings.com
2. USG
800.950.3839
www.usg.com
3. Hunter Douglas Architectural
800.727.8953
www.hunterdouglasarchitectural.com
4. Or prior approved equal.

B. Suspension Systems:

1. Armstrong World Industries, Inc. – Basis of Design
717.397.0611 / 877.ARMSTRONG
www.armstrongworldindustries.com
Armstrong Ceilings Manufacturer Representative: Catherine Nipper
cmnipper@armstrongceilings.com
2. USG
800.950.3839
www.usg.com
3. Hunter Douglas Architectural
800.727.8953
www.hunterdouglasarchitectural.com
4. Or prior approved equal.

C. Aluminum Custom Trims:

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1. Armstrong World Industries, Inc. – Basis of Design
717.397.0611 / 877.ARMSTRONG
www.armstrongworldindustries.com
Armstrong Ceilings Manufacturer Representative: Catherine Nipper
cmnipper@armstrongceilings.com
2. USG
800.950.3839
www.usg.com
3. Hunter Douglas Architectural
800.727.8953
www.hunterdouglasarchitectural.com
4. Or prior approved equal.

2.2 MATERIAL SPECIFICATION:

A. Acoustical Panels Type ACP-1

1. Acoustical Panels Type ACP-1:
 - a. Surface Texture: Smooth, M2 Micro-perforation
 - b. Composition: Metal
 - c. Color: Effects Wood Color To Be Determined (Select from manufacturer's full range of standard colors)
 - d. Size: 6" x 96"
 - e. Edge Profile: Square with extended flange
 - f. Perforation Option: Round - Diagonal
 - g. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton 0.70
 - h. Ceiling Attenuation Class (CAC):
 - i. Sabin: N/A
 - j. Articulation Class (AC):
 - k. Flame Spread: ASTM E 1264; Class A.
 - l. Light Reflectance (LR) White Panel: ASTM E 1477; 0.61.
 - m. Dimensional Stability: Standard
 - n. Recycle Content: Post-Consumer - Pre-Consumer -
 - q. Acceptable Product: METALWORKS Linear - Classics, 7161 M2 Micro-perforation

No added formaldehyde as manufactured by Armstrong World Industries

2. Metal Panel Accessories:

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1. 5346 - 6" Effects Wood Looks Trim
2. 7162 - MetalWorks Linear 6" Panel End Cap
3. 7166 - MetalWorks Linear Carrier Splice for 6"
4. 7177 - MetalWorks Linear Main Beam Carrier Assembly
5. 7239 - Adjustable Trim Clip

B. Acoustical Panels Type ACP-2

1. Acoustical Panels Type ACP-2 (Interior):
 - a. Surface Texture: Smooth
 - b. Composition: Electrogalvanized Steel 0.028"
 - c. Color: Effects Color - To Be Determined from manufacturer's full range of standard wood finishes
 - d. Size: 13IN x 96IN
 - e. Edge Profile: Linear
 - f. Perforation Option: Microperforated M2
 - g. Noise Reduction Coefficient(NRC): 0.70
 - h. Ceiling Attenuation Class (CAC) : N/A
 - i. Sabin: N/A
 - j. Articulation Class (AC): N/A
 - k. Flame Spread: ASTM E 1264; Class A (FM)
 - l. Light Reflectance: N/A
 - m. Dimensional Stability: Standard
 - n. Acceptable Product: Armstrong MetalWorks Linear - Synchro, (8223W13M2) as manufactured by Armstrong World Industries; NOTE: Contact Armstrong for installation guidance and training on the new Metalworks Linear Synchro system.
2. Infill Metal Panel Accessories:
 - a. 8233W13M1___13IN End Cap
 - b. 7113 – Spreader Hold Down
 - c. 7237 – Cut Plank Support
 - d. 7277MF – Main Beam Carrier 2 (MBCB) -Mill Finish
 - e. 5574___-Carrier Molding
 - f. 7239 – Adjustable Trim Clip
 - g. 8161 – Metalworks Linear Pressure Spring

2.3 ALUMINUM CUSTOM TRIM – EXTRUDED

Product/Manufacturer: Axiom Trim Channel: 6in Axiom Classic Straight Armstrong World Industries, Incorporated

A. Commercial quality extruded aluminum alloy 6063 trim channel, factory finished in baked polyester paint. Commercial quality galvanized steel unfinished T-bar connection clips; galvanized steel splice plates.

1. Color: Color To Be Determined (Select from manufacturer's full range of standard colors)
2. Size: 120" X 6"
3. Recycle Content: Post-Consumer - 10% Pre-Consumer - 35%
4. Acceptable Product: AXIOM Classic, 6in Axiom Classic Straight as manufactured by Armstrong World Industries

B. Axiom Trim Channel:

6in Axiom Classic Straight

C. Axiom Outside Corner Posts (Straight Only):

1. 6in Axiom Classic Outside Corner Post

D. Axiom Inside Corners (Straight Only):

1. 6" Axiom Classic Inside Corner Post

E. Axiom Accessories:

None

PART 3 – EXECUTION

3.1 EXAMINATION

A. Installer must inspect the area where the ceiling system is to be installed for conditions that may affect the work and notify the Contractor in writing of any unsatisfactory conditions before proceeding.

B. All work above the ceiling system is to be satisfactorily completed prior to start of the ceiling installation.

C. All unsatisfactory conditions potentially affecting the ceiling system are to be corrected prior to the start of ceiling installation.

D. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.

3.2 PREPARATION

A. Verify and confirm ceiling layouts by actual field measurements to balance borders and minimize out-of-square conditions. Coordinate all work that penetrates the ceiling.

B. Ceiling systems shall be properly laid out per the manufacturer's installation instructions or as shown on the approved shop drawings.

C. Cutouts for lights, speakers, sprinklers or other items can be done on site.

3.3 INSTALLATION

Install the suspended ceiling system in accordance with the manufacturer's printed installation instructions, LA-297437; applicable industry standards; and local regulations and requirements in effect.

3.4 ADJUSTING AND CLEANING

Adjust ceiling components to provide a consistent finish and appearance in conformity with preestablished tolerances and requirements. All panels showing signs of damage, either in finish or in form are to be replaced. All exposed surfaces are to be cleaned of any dirt, grease, fingerprints and marks or other imperfections with cleaning materials recommended by the manufacturer

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Samples.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Products:
 - 1. Tarkett / Johnsonite
 - 2. Flexco.
 - 3. Mannington Commercial Rubber.
 - 4. Approved Equivalent.
- B. Color: As selected.
- C. ASTM F 1861, Type TS Rubber, Vulcanized Thermoset, Homogeneous Color.
- D. Style: Cove base with toe.
- E. Minimum Thickness: .125 inch thick.
- F. Height: 4 inches
- G. Lengths: Cut lengths in manufacturer's standard coil lengths.
- H. Outside Corners: Job Formed, Wrapped Corners.
- I. Inside Corners: Job Formed.
- J. Finish: Satin.
- K. Style & Color:
 - a. RB-1: Size: 4" Cove Base
 - 1) Tarkett/Johnsonite, Wallbase, Duracove Thermoplastic Rubber (Type TP) Coved (DC-XX), Color: to be selected by Architect from Manufacturers Standard Range
 - 2) Flexco, Wall Base, Style: TS Wallflowers Rubber Base, Color: to be selected by Architect from Manufacturers Standard Range

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2.2 RESILIENT MOLDING ACCESSORY

- A. Products:
 - 1. Tarkett/Johnsonite.
 - 2. Flexco.
 - 3. Mannington Commercial Rubber.
 - 4. Approved Equivalent.
- B. Color: To Match Rubber Base.
- C. Description: As selected.
- D. Material: As selected.
- E. Profile and Dimensions: As indicated.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement- or blended hydraulic cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit products and substrate conditions.
- C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- E. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare concrete substrates according to ASTM F 710. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
- B. Adhesively install resilient wall base and accessories.
- C. Install wall base in maximum lengths possible. Apply to walls, columns, pilasters, casework, and other permanent fixtures in rooms or areas where base is required.
- D. Install stair-tread-nose filler to nosing substrates that do not conform to tread contours.
- E. Install reducer strips at edges of floor coverings that would otherwise be exposed.
- F. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.

RESILIENT BASE AND ACCESSORIES

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1. Apply three coats.

END OF SECTION 09 65 13

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and Samples.
- B. Extra Materials: Deliver to Owner one box for each type and color of resilient floor tile installed.

PART 2 - PRODUCTS

2.1 LUXURY VINYL PLANK

- A. Manufacturers:
 - 1. Tarkett, (Event Series – Basis of Design)
 - 2. Mannington Mills,
 - 3. Approved equivalent.
- B. Color and Pattern: Selected by Architect from manufacturers full product line. Color may vary by application and adjacent tile color & pattern. Multiple colors may be used. Refer to plans.
- C. ASTM F 1066.
- D. Fire-Test Response: Critical radiant flux classification of Class I, not less than 0.45 W/sq. cm per ASTM E 648.
- E. Wearing Surface: Textured
- F. Thickness: 0.120 inch.
- G. Size: 6 by 48 inches.
- H. Wear Layer: 30 mil
- I. Sustainability: Low VOC: Reduce quantity of indoor contaminants by specifying materials in compliance with the followings:
 - 1. Meet testing and requirements of Green Label Plus Program (VOC limit of 50g/L)
 - 2. Adhesives and Sealants: SCAQMD Rule #1168.

2.2 RESILIENT MOLDING ACCESSORY

- A. Description:
 - 1. Reducer strip for resilient floor covering.
- B. Products:
 - 1. Tarkett.
 - a. Marley Flexco (USA), Inc.
 - b. Roppe Corporation.
 - c. Approved Equivalent.
- C. Material: Rubber.
- D. Profile and Dimensions: color and size/profile selected by architect.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement- or blended hydraulic cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- B. Adhesives: Premium, clear, water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
- C. Floor Polish: Protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare concrete substrates according to ASTM F 710. Verify that substrates are dry and free of curing compounds, sealers, and hardeners. Comply with manufacturer's recommendations for preparation of substrate.

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- B. Clean floor and apply, trowel and float filler to leave smooth, flat and hard surface; prohibit traffic in area until filler is cured.
- C. Lay out tiles so tile widths at opposite edges of room are equal and are at least one-half of a tile.
- D. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged. Install Planks in the same direction, in a random UNIDIRECTIONAL pattern, and offset plank end joints by a min. of 6" (15.2cm). Avoid "Stair-step" and "H- Pattern" Layouts by using random sizing 6" and larger to start each row.
- E. Clean substrate.
- F. Spread adhesive evenly in quantity recommended by manufacturer to ensure adhesion over entire area of installation; spread enough adhesive to permit installation of flooring before initial set.
- G. Set flooring in place, press with heavy roller to ensure full adhesion.
- H. Lay flooring with joints parallel to building lines to produce symmetrical pattern unless shown otherwise.
- I. Terminate resilient flooring at centerline of door openings where adjacent floor finish is dissimilar.
- J. Install edge strips at unprotected and exposed edges where flooring terminates.
- K. Fit flooring to walls, columns, floor outlets and other appurtenances, to produce net joints.
- L. Consult with Architect for floor pattern desired in each area.

3.2 CLEANING, POLISHING AND PROTECTION

- A. Remove excess adhesive from floor, base and wall surfaces without causing damage to surfaces due to cleaning operations, and repair damage to adjacent materials caused by resilient tile installation using methods recommended by adjacent material manufacturers.
- B. Allow adhesive to fully set before cleaning.
- C. Prohibit traffic on floor for minimum 48 hours after installation, or as recommended by manufacturer.
- D. When construction traffic is anticipated, take measures to ensure no materials are damaged. Damaged materials are defined as having cuts, gouges, scrapes or tears and any material or portions of material not fully adhered.
- E. Floors to be stripped to remove dirt, marks and manufacturer's mill finish and contractor must apply seven (7) coats of floor polish. Burnish to a high gloss after the fifth (5th) coat and apply two (2) additional coats of wax.

END OF SECTION

SECTION 09 67 66 - POLYURETHANE FLOOR SYSTEM

Part 1- GENERAL

1.01 DESCRIPTION

A. Scope

1. The complete installation of polyurethane surfacing over high-performance resilient base mat, including adhesives, base mat, polyurethane sealer, polyurethane structure layer, surface topcoat, and court markings.

B. Related work specified under other sections.

1. Concrete and Concrete Finishing.....Section 03300
 - a. Concrete Slab Depression: a total of 10 mm, equal to system thickness, (0.3937 inches).
 - b. Surface Finish: steel troweled and finished smooth.
 - c. Concrete Tolerance: 1/8" (3mm) in radius of 10' (3m). Floor Flatness and Floor Levelness (FF and FL) numbers are not recognized.
 - d. NO CURING AGENTS OR SEALERS ARE TO BE APPLIED TO THE CONCRETE SLAB.
2. Membrane Waterproofing and Dampproofing.....Section 07100
 - a. Concrete subfloors on or below grade shall be adequately waterproofed beneath the slab and at the perimeter walls and on the earth side of below grade walls by general contractor using suitable type membrane.
 - b. Sand-Poly-Sand slab construction is not an acceptable construction.

1.02 QUALITY ASSURANCE

A. Floor System Supplier Qualifications

1. Supplier shall be an established firm experienced in field and have been in business for a minimum of ten (10) years, Robbins, Inc. or an approved equal.
2. Formulator shall be ISO-9001 certified for quality control, and ISO-14001 certified for environmental care, and provide copy of Certification document upon request.

B. Floor Contractor/Installer Qualifications and Certifications

1. Floor Contracting Company and field personnel shall be trained by supplier on proper installation and finishing process.

C. System Technical Data:

| <u>Technical Data</u> | | | |
|---------------------------------|-----------------------------------|-----------------|-------------|
| Character | Point-elastic | | |
| Classification | n/a | | |
| Nominal thickness | 10 mm | (0.3937 inches) | |
| Shock Absorption | 20% | | EN 14808 |
| Vertical Deformation | 1.0 mm | | EN 14809 |
| Linear Friction (dry) | 70 | | EN 13036-4 |
| Linear Friction (damp) | R9 | | Leroux |
| Ball Bounce | 98 % | | EN 12235 |
| Gloss | 3%-7% | | EN 2813 |
| Resistance to rolling load | 0.05 mm | | EN 1569 |
| Resistance to impact | ≥800 gr @ 10°C | | EN 1517 |
| | ≥1200 gr @ 17°C | | EN 1517 |
| Resistance to indentation | 0.50 mm @ 5 min | | EN 1516 |
| | 0.15 mm @ 24 hrs | | EN 1516 |
| Resistance to wear | 150 mg | | EN ISO 5470 |
| Flammability | Cfl-S2 | | EN 13501-1 |
| V.O.C. content - Adhesive | Solvent free | | |
| V.O.C. content - Topcoat | 0.01 gr/lit (EU) | | 2004/42/EG |
| Adhesive composition | Free of solvents and heavy metals | | |
| Resin composition | Free of solvents and heavy metals | | |
| Elongation at break - Structure | 230% | | DIN 53455 |
| Tensile Strength - Structure | 11 N/mm2 | (1,595 psi) | DIN 53455 |
| Tear Strength - Structure | 28 N/mm | (159 pli) | DIN 53515 |

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1.03 SUBMITTALS

- A. Manufacturer's Product Data
 - 1. Floor System specification sheets.
- B. Concrete Guidelines
 - 1. Submit Concrete Recommendations for correct preparation, finishing and testing of concrete subfloor surfaces to receive granulated base mat and polyurethane floor system.
- C. Samples
 - 1. Submit one (1) sample Polyurethane floor system
 - 2. Submit one Topcoat Standard Color Chart
 - 3. Submit one Linepaint Color Chart
- D. Maintenance Literature
 - 1. Submit copy Maintenance Instructions.
- E. References
 - 1. Submit Letter attesting that Floor Contractor and Field Personnel have been properly trained to perform work per specifications and contract.
 - 2. Reference list of three individual for whom installer has worked on projects of similar size and magnitude.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials
 - 1. Material shall not be delivered or installed until all masonry, painting, plastering, tile work, marble and terrazzo work are completed and all overhead mechanical work, lighting, backstops, scoreboards are installed. Room temperature shall be at least 55 degrees Fahrenheit, and ambient relative humidity shall be 80% or less. Moisture content of concrete substrate must be <5% by mass as measured with a Tramex® CME/CMExpert type concrete moisture meter (or sim). If moisture content of concrete substrate is >5% by mass as measured with Tramex® CME/CMExpert type, optional moisture mitigation systems or moisture tolerant primer can be applied. Coordinate with Manufacturer's recommendations.
 - 2. Area where materials are to be stored should be maintained at 55 degrees Fahrenheit and under 75% relative humidity by the General Contractor.

1.05 JOB CONDITIONS-SEQUENCY

- A. Do not install floor system until concrete has been cured 60 days and the requirements in paragraph 1.01 and 1.04 are obtained.
- B. General Contractor is responsible to ensure slab is clean and free of all dirt and debris prior to floor installation beginning.
- C. Permanent heat, light and ventilation shall be installed and operating during and after installation. Environmental temperatures must average a minimum of 65 degrees Fahrenheit for one full week proceeding, throughout, and 72 hours following application.
- D. After floors are finished, area to be kept locked by general contractor to allow curing time for the paint and finish system(s). No other trades are to be allowed on floor until it is accepted in writing by owner or owner's authorized agent.

1.06 GUARANTEE

- A. Guarantee shall not cover damage caused in whole or in part by casualty, ordinary wear and tear, abuse, use for which material is not designed, faulty construction of the building, settlement of the building walls, failure of the other contractors to adhere to specifications, separation of the concrete slab and excessive dryness or excessive moisture from humidity, spillage, migration through the slab or wall, or any other source.
- B. Robbins, Inc. hereby warrants the Pulastic GT 100 material to be free from manufacturing defects for a period of 1 year. This warranty is in lieu of all other warranties, expressed or implied including but not limited to any warranty of merchantability or fitness for a particular purpose, and of any other obligations on the part of Robbins. In the event of breach of any warranty, the liability of Robbins shall be limited to repairing or replacing Pulastic GT 100 material and system components supplied by Robbins and proven to be defective in manufacture, and shall not include any other damages, either direct or consequential.

Part 2-PRODUCTS

2.01 MATERIALS

NOTE: all applicable components must be recommended by single source manufacturer

- A. Robbins PULASTIC (Basis of Design)
 - 1. Adhesive
 - a. Pulastic Tacly Adhesive: a two-component polyurethane adhesive

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2. Base Mat
 - a. Base Mat, a granulated high-density rubber mat 7mm thick.
3. Pad Sealer
 - a. Pulastic EG2000 Sealer: a two-component polyurethane sealer
4. Polyurethane Resin
 - a. Pulastic GM2500 Compound: a pigmented two-component polyurethane resin
5. Coating
 - a. Pulastic Multicoat: a pigmented, two-component, water-dispersed polyurethane surface coating.
 - b. Option: Deco
 - 1) Pulastic PU221W: a pigmented, two-component, water-dispersed polyurethane coating.
 - 2) Deco Chips: PVC color flakes.
 - 3) Pulastic Multicoat Clear E: a clear, two-component, water-dispersed surface coating.

Part 3-EXECUTION

3.01 INSPECTION

- A. Inspect concrete slab for proper levelness tolerance, dryness, and possible contamination, (see Part 1 –Sec 1.01 and Sec. 1.04) and report any discrepancies to the general contractor and architect in writing.
- B. All work required to put the concrete subfloors in acceptable condition shall be the responsibility of the general contractor.
- C. Subfloor shall be broom cleaned by general contractor.
- D. General Contractor will notify the flooring installation company to proceed with the installation after concrete slab specifications are met.
- E. Installer shall perform tests for moisture and adhesion prior to application and report adverse conditions to the general contractor in writing.
- F. Installer shall document all working conditions provided in General Specifications prior to commencement of installation.

3.02 INSTALLATION

- A. Robbins Pulastic
 1. Base Mat
 - a. Mix two-component Taclly Adhesive according to supplier's instructions and spread adhesive using ROBBINS PULASTIC notched trowel.
 - b. Unroll polyurethane/rubber granulated base mat into freshly applied adhesive. Seams shall be in virtual contact with absence of compression fit. Roll surface of base mat with a medium-size roller.
 2. Sealer
 - a. Mix two-component EG2000 Sealer according to supplier's instructions and spread sealer over base mat using a straight trowel. Allow to cure minimum 12 hours before proceeding.
 3. Structure Layer
 - a. Mix two-component ROBBINS PULASTIC GM2500 pigmented polyurethane resin and spread over EG Sealer according to supplier's instructions. Allow to cure minimum 12 hours before proceeding.
 - b. Mix two-component ROBBINS PULASTIC GM2500 pigmented polyurethane resin and apply at proper thickness according to supplier's instructions. Allow to cure minimum 12 hours before proceeding.
 4. TopCoat
 - a. Mix two-component ROBBINS PULASTIC Multicoat and apply according to suppliers' instructions. Allow 24 to 48 hours curing time before proceeding.
 - b. Option: Deco
 - 1) Mix two-component ROBBINS PULASTIC PU221W and apply using Pulastic Lambswool rollers, and broadcasting Deco Chips into the wet coating according to supplier's instructions. Allow to properly cure 16 to 24 hours before proceeding.
 - 2) Prep surface according to supplier's instructions.
 - 3) Mix two-component ROBBINS PULASTIC Multicoat Clear E and apply according to supplier's instructions. Allow to properly cure 16 to 24 hours.
 - 4) Repeat Step 3.
- B. Perimeter Molding (Optional):
 1. Install a rubber base, anchored to the walls with standard base cement.

3.03 CLEANING

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1. Clean up all unused materials and debris and remove from the premises. Dispose of empty containers in accordance with federal and local regulations.

3.04 PROTECTION

1. Cure Time
 - a. No traffic or other trades shall be allowed on the surface for a period of one week following completion to allow for complete and proper cure of the finish.
2. Other Trades
 - a. It shall be the responsibility of the general contractor to protect the surface from damage by other trades before acceptance by the owner or the owner's authorized agent.
3. Safety
 - a. No smoking, open flames or sparks from electrical equipment or any other source shall be permitted during the installation process, or in areas where materials are stored

END OF SECTION 096766

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes modular, tufted carpet tile.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who is experienced in commercial carpet installations.
- B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.8 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

1.9 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

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1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, loss of tuft bind strength, loss of face fiber, and delamination.
3. Warranty Period: 10 years minimum from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE CPT-1 & CPT-3 (Same Carpet / Different Color)

- A. Products: Subject to compliance with requirements, provide the following:
 1. Tarkett, Suede Tones, #11531 (Basis of Design)
 2. Approved Equal
- B. Color: As selected by Architect from manufacturer's full range.
- C. Dye Method: 100% Solution Dyed
- D. Fiber Type: Dynex SD Nylon (Permanent Stain Resistance)
- E. Construction: Stratatec (Patterned Symtex)
- F. Density: 14233 Oz/cu. yd. (526.6 kg/cu m.)
- G. Stitches: 9.6 stitches per inch (37.8 pu/10cm)
- H. Gage: 5/64 (50.4 rows / 10cm)
- I. Face Weight: 17 oz./sq. yd.
- J. Primary Backing/Backcoating: Synthetic Non-Woven
- K. Size: 18 by 36 inches , vertical ashlar installation
- L. Applied Soil-Resistance Treatment: Florine Free Soil Protection – Eco Ensure

2.2 CARPET TILE CPT-2

- A. Products: Subject to compliance with requirements, provide the following:
 1. Tarkett, Aida Cloth # G0052 (Basis of Design)
 2. Approved Equal
- B. Color: Custom Color / Pattern
- C. Dye Method: 100% Solution Dyed
- D. Fiber Type: Dynex SD Nylon (Permanent Stain Resistance)
- E. Construction: Tufted Patterned Loop

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- F. Density: 12000 Oz/cu. yd. (444 kg/cu m.)
- G. Stitches: 9.4 stitches per inch (37.0 pu/10cm)
- H. Gage: 1/10 (39.4 rows / 10cm)
- I. Face Weight: 25 oz./sq. yd.
- J. Primary Backing/Backcoating: Synthetic Non-Woven
- K. Size: 18 by 36 inches , vertical ashlar installation
- L. Applied Soil-Resistance Treatment: Florine Free Soil Protection – Eco Ensure

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for 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).

PART 3 - EXECUTION

3.1 INSTALLATION

- 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 carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Preparation: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- E. Installation: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- F. Installation Method: As recommended in writing by carpet tile manufacturer.
- G. Maintain dye lot integrity. Do not mix dye lots in same area.
- H. Cut and fit carpet tile 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 tile manufacturer.

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- I. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- J. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- K. Install pattern parallel to walls and borders.
- L. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- M. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

END OF SECTION 096813

SECTION 097700 – FIBERGLASS REINFORCED WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Prefinished polyester glass reinforced plastic sheets and adhered to unfinished [gypsum] wallboard.
 - 1. [PVC] trim.
- B. Products Not Furnished or Installed under This Section:
 - 1. Gypsum [Cementitious] substrate board.
 - 2. Resilient Base.

1.2 RELATED SECTIONS

- A. Section 092900 – Gypsum Board Assemblies.
- B. Section 054000 – Cold Formed Metal Framing
- C. Section 096513 - Resilient Base and Accessories

1.3 REFERENCES

- A. American Society for Testing and Materials: Standard Specifications (ASTM)
 - 1. ASTM D 256 - Izod Impact Strengths (ft #/in)
 - 2. ASTM D 570 - Water Absorption (%)
 - 3. ASTM D 638 - Tensile Strengths (psi) & Tensile Modulus (psi)
 - 4. ASTM D 790 - Flexural Strengths (psi) & Flexural Modulus (psi)
 - 5. ASTM D 2583- Barcol Hardness
 - 6. ASTM D 5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
 - 7. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

- A. Product Data: Submit sufficient manufacturer's data to indicate compliance with these specifications, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Shop Drawings: Submit elevations of each wall showing location of paneling and trim members with respect to all discontinuities in the wall elevation.
- C. Selection Samples: Submit manufacturer's standard color pattern selection samples representing manufacturer's full range of available colors and patterns.
- D. Samples for Verification: Submit appropriate section of panel for each finish selected indicating the color, texture, and pattern required.
 - 1. Submit complete with specified applied finish.

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2. For selected patterns show complete pattern repeat.
 3. Exposed Molding and Trim: Provide samples of each type, finish, and color.
- E. Manufacturers Material Safety Data Sheets (MSDS) for adhesives, sealants and other pertinent materials prior to their delivery to the site (available as downloads for most Marlite's products at <http://www.marlite.com/tech-details.aspx> or by contacting Marlite at info@marlite.com).

1.5 QUALITY ASSURANCE

- A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:
1. ASTM E 84 (Method of test for surface burning characteristics of building Materials)
 - a. Wall Required Rating – Class [A]
- B. Sanitary Standards: System components and finishes to comply with:
1. United States Department of Agriculture (USDA) / Food Safety & Inspection Services (FSIS) requirements for food preparation facilities, incidental contact.
 2. Food and Drug Administration (FDA) 2013 Food Code 6-101.11.
 3. Canadian Food Inspection Agency (CFIA) requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials factory packaged on strong pallets.
- B. Store panels and trim lying flat, under cover and protected from the elements. Allow panels to acclimate to room temperature (range of 60 to 75°F) for 48 hours prior to installation.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Building are to be fully enclosed prior to installation with sufficient heat (70°) and ventilation consistent with good working conditions for finish work
- B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
1. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

1.8 WARRANTY

- A. Furnish one-year guarantee against defects in material and workmanship.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Marlite; 1 Marlite Drive, Dover, OH 44622. 800-377-1221 FAX (330) 343-4668 Email: info@marlite.com
www.marlite.com.
- B. Or Approved Equal

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- C. Product:
 - 1. Standard FRP
 - 2. Laminated FRP

2.2 PANELS

- A. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
 - 1. Dimensions:
 - a. Thickness – 0.090 " (2.29mm) nominal
 - b. Width - 4'-0" (1.22m) nominal
 - c. Length – [10'-0" (3.0m)][8'-0" (2.4m)] [As indicated on the drawings] nominal
 - 2. Tolerance:
 - a. Length and Width: +/-1/8 " (3.175mm)
 - b. Square - Not to exceed 1/8 " for 8 foot (2.4m) panels or 5/32 " (3.96mm) for 10 foot (2.4m) panels
- B. Properties: Resistant to rot, corrosion, staining, denting, peeling, and splintering.
 - 1. Flexural Strength - 1.7×10^4 psi per ASTM D 790.
 - 2. Flexural Modulus – 6.0×10^5 psi per ASTM D 790.
 - 3. Tensile Strength – 8.0×10^3 psi per ASTM D 638.
 - 4. Tensile Modulus – 9.43×10^5 psi per ASTM D 638.
 - 5. Water Absorption - 0.17% per ASTM D 570.
 - 6. Barcol Hardness (scratch resistance) of 30 as per ASTM D 2583.
 - 7. Izod Impact Strength of 7.0 ft. lbs./in ASTM D 256
- C. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.
- D. Front Finish: [Smooth, S490N S2S Light Grey]
 - a. Size: standard sizes are;
 - 1) Marlite Standard FRP
 - a) 48" x 96" [1.2m x 2.4m] x .090" (3mm) nom.
 - b) 48" x 108" [1.2m x 2.7m] x .090" (3mm) nom.
 - c) 48" x 120" [1.2m x 3m] x .090" (3mm) nom.
 - 2) Ceiling panels (designed for suspended ceiling installation)
 - a. 23 3/4" x 47 3/4" (0.6m x 1.2m) x .090" (3mm)
 - b. 23 3/4" x 23 3/4" (0.6m x 0.6m) x .090" (3mm)Can be specified as FRP panels only or backed with 5/8" FR Drywall.
 - 3) Laminated FRP
 - a. 48" x 96" [1.2m x 2.4m] x .090" (3mm) nom.

2.3 MOLDINGS

PVC Trim: Thin-wall semi-rigid extruded PVC.

- 1. M 350 Inside Corner, [8' length][10' length]
- 2. M 360 Outside Corner, [8' length][10' length]
- 3. M 365 Division, [8' length][10' length]

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4. M 370 Edge, [8' length][10' length]
5. V 177 135° Inside Corner [8' length] [White only]
6. V 179 135° Outside Corner [8' length] [White only]
7. Color: [White][Beige][Natural Almond][Ivory][Silver][Light Grey][Black]

2.4 ACCESSORIES

- A. Adhesive: Either of the following construction adhesives complying with ASTM C 557.
 1. Marlite C-551 FRP Adhesive - Water-resistant, non-flammable adhesive.
 2. Marlite C-915 Construction Adhesive - Flexible, water-resistant, solvent based adhesive, formulated for fast, easy application.
 3. Titebond Advanced Polymer Panel Adhesive – VOC compliant, non-flammable, environmentally safe adhesive.
- B. Sealant:
 1. Marlite Brand MS-250 Clear Silicone Sealant.
 2. Marlite Brand MS-251 White Silicone Sealant.
 3. Marlite Brand - Color Match Sealant.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
 1. Verify that stud spacing does not exceed 24" (61cm) on-center.
- B. Repair defects prior to installation.
 1. Level wall surfaces to panel manufacturer's requirements. Remove protrusions and fill indentations.

3.2 INSTALLATION

- A. Comply with manufacturer's recommended procedures and installation sequence.
- B. Cut sheets to meet supports allowing 1/8" (3 mm) clearance for every 8 foot (2.4m) of panel.
 1. Cut and drill with carbide tipped saw blades or drill bits, or cut with shears.
 2. Pre-drill fastener holes 1/8" (3mm) oversize with high speed drill bit.
 - a. Space at 8" (200mm) maximum on center at perimeter, approximately 1" from panel edge.
 - b. Space at in field in rows 16' (40.64cm) on center, with fasteners spaced at 12" (30.48 cm) maximum on center.
- C. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.
 1. Install panels with manufacturer's recommended gap for panel field and corner joints.
 - a. Adhesive trowel and application method to conform to adhesive manufacturer's recommendations.
 - b. Drive fasteners for snug fit. Do not over-tighten.
- D. Apply panel moldings to all panel edges using silicone sealant providing for required clearances.
 1. All moldings must provide for a minimum 1/8" (3mm) of panel expansion at joints and edges, to insure proper installation.

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2. Apply sealant to all moldings, channels and joints between the system and different materials to assure watertight installation.

3.3 CLEANING

- A. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.
- B. Refer to manufacturer's specific cleaning recommendations Do not use abrasive cleaners.

END OF SECTION 09 7700

SECTION 099113 – EXTERIOR PAINTING

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 surface preparation and the application of paint systems on exterior substrates:

1. Concrete.
2. Clay masonry.
3. Concrete masonry units (CMU).
4. Steel.
5. Galvanized metal.
6. Aluminum (not anodized or otherwise coated).
7. Stainless-steel flashing.
8. Wood.
9. Plastic trim fabrications.
10. Exterior portland cement plaster (stucco).
11. Exterior gypsum board.

- B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
2. Section 099600 "High-Performance Coatings" for special-use coatings.
3. Section 099123 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
4. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on exterior wood substrates.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523, a matte flat finish.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, a high-side sheen flat, velvet-like finish.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, an eggshell finish.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523, a satin-like finish.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523, a semi-gloss finish.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523, a gloss finish.

1.4 ACTION SUBMITTALS

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- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, **8 inches (200 mm)** square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. VOC content.

1.5 CLOSEOUT SUBMITTALS

- A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than **1 gal. (3.8 L)** of each material and color applied.

1.7 QUALITY ASSURANCE

- A. Mockups: Apply mockups 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 in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least **100 sq. ft. (9 sq. m)**.
 - b. 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.

1.8 DELIVERY, STORAGE, AND HANDLING

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- A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacture's label with the following information:
 - 1. Product name and type (description).
 - 2. Batch date.
 - 3. Color number.
 - 4. VOC content.
 - 5. Environmental handling requirements.
 - 6. Surface preparation requirements.
 - 7. Application instructions.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
- D. Hazardous Materials: Hazardous materials including lead paint may be present in existing buildings and structures to be painted. A report on the presence of known hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified.
 - 2. Perform preparation for painting of substrates known to include lead paint in accordance with EPA Renovation, Repair and Painting Rule and additional requirements of authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company products indicated or comparable product from one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Sherwin Williams Co.
 - 3. Behr Corporation
 - 4. Glidden Professional, Division of PPG Architectural Finishes, Inc.
 - 5. PPG Architectural Finishes, Inc.
 - 6. Pratt & Lambert.

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- B. Source Limitations: Obtain paint materials from single source from single listed manufacturer.
 - 1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
- C. Colors: [As selected by Architect from manufacturer's full range] [Match Architect's samples] [As indicated in a color schedule] <Insert requirements>.
 - 1. 10 percent of surface area will be painted with deep tones.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 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. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
 - 1. Report, in writing, conditions that may affect application, appearance, or performance of paint.
- B. Substrate Conditions:
 - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.

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- c. Wood: 15 percent.
 - d. Portland Cement Plaster: 12 percent.
 - e. Gypsum Board: 12 percent.
- 2. Portland Cement Plaster Substrates: Verify that plaster is fully cured.
 - 3. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
- 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
- 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
- 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
 - 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 - 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
- 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.

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2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

- K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 4. Paint entire exposed surface of window frames and sashes.
 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. 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. Paint the following work where exposed to view:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

EXTERIOR PAINTING

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- 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.

3.6 EXTERIOR PAINTING SCHEDULE

- A. [Concrete] [Clay Masonry] [Portland Cement Plaster (Stucco)] [Cementitious Siding], Nontraffic Surfaces:
 - 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, exterior: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
 - b. Prime Coat: Latex, exterior, matching topcoat.
 - c. Intermediate Coat: Latex, exterior, matching topcoat.
 - d. Topcoat: Latex, exterior, flat: S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.
 - e. Topcoat: Latex, exterior, low-sheen: S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - f. Topcoat: Latex, exterior, satin: S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - g. Topcoat: Latex, exterior, semi-gloss: S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - h. Topcoat: Latex, exterior, gloss: S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.
 - 2. Latex Aggregate/Latex System:
 - a. Prime Coat: Block Filler, Latex, Interior/Exterior: S-W Loxon Block Surfacer, A24W200, at 50 to 100 sq. ft. per gal (1.2 to 2.4 sq. m per l).
 - b. Topcoat: Latex, exterior flat, medium texture: S-W UltraCrete Textured Masonry Topcoat, A44-800 Series, at 50 to 80 sq ft./gal. 50 to 100 sq. ft. per gal.
 - 3. Concrete Stain System (Water-based):
 - a. First Coat: Low-luster opaque finish matching topcoat.
 - b. Topcoat: Low-luster opaque finish: S-W H&C Concrete Stain Solid Color Water Based, A31 Series, at 50 to 250 sq. ft. per gal (1.2 to 6.1 sq. m per l).
- B. Concrete Substrates, Pedestrian Traffic Surfaces:
 - 1. Latex Floor Paint System:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.
 - 2. Concrete Stain System (Water-based) for Vertical Surfaces:
 - a. First Coat: Low-luster opaque finish matching top coat.

- b. Topcoat: Low-luster opaque finish: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 250 sq. ft. per gal (1.2 to 6.1 sq. m per l).
 - C. CMU Substrates:
 - 1. Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior: S-W PrepRite Block Filler, B25W25, at 75 to 125 sq. ft. per gal (1.8 to 3.1 sq. m per l).
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, flat: S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.
 - d. Topcoat: Latex, exterior, low-sheen: S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - e. Topcoat: Latex, exterior, satin: S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - f. Topcoat: Latex, exterior, semi-gloss: S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - g. Topcoat: Latex, exterior, gloss: S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.
 - 2. CMU Stain System (Water-based):
 - a. First Coat: Low-luster opaque finish matching topcoat.
 - b. Topcoat: Low-luster opaque finish: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 250 sq. ft. per gal (1.2 to 6.1 sq. m per l).
- D. Ferrous Metal, Galvanized-Metal, and Aluminum Substrates:
 - 1. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, water-based, anti-corrosive for metal: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, 5.0 to 10.0 mils wet, 2.0 to 4.0 mils dry.
 - b. Prime Coat: Shop primer specified in Section where substrate is specified.
 - c. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - d. Topcoat: Light industrial coating, exterior, water based, eggshell: S-W Pro Industrial Eg-Shel Acrylic B66-660 Series, at 2.5 to 4.0 mils dry, per coat.
 - e. Topcoat: Light industrial coating, exterior, water based, semi-gloss: S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.
 - f. Topcoat: Light industrial coating, exterior, water based, gloss: S-W Pro Industrial Acrylic Gloss Coating, B66-600 Series, at 2.5 to 4.0 mils dry, per coat.
- E. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.
 - 1. Latex System:
 - a. Prime Coat: Primer, latex for exterior wood.
 - a. Intermediate Coat: Latex, exterior, matching topcoat.
 - b. Topcoat: Latex, exterior, flat: S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.
 - c. Topcoat: Latex, exterior, low-sheen: S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - d. Topcoat: Latex, exterior, satin: S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

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- e. Topcoat: Latex, exterior, semi-gloss: S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - f. Topcoat: Latex, exterior, gloss: S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.
- F. Wood Substrates, Pedestrian Traffic Surfaces:
- 1. Latex Floor Paint System:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.
 - 2. Solid Color Stain System:
 - a. First Coat: Solid color stain, latex, matching topcoat.
 - b. Topcoat: Solid color stain, latex, slip-resistant, flat, interior/exterior: S-W DeckScapes Exterior Acrylic Solid Color Deck, A15-Series, at 200 to 400 sq. ft. per gal (4.9 to 9.8 sq. m per l).
- G. Plastic Trim Fabrication Substrates: Including architectural PVC, plastic, and fiberglass items.
- 1. Latex System:
 - a. Prime Coat: Primer, bonding, water-based: S-W PrepRite ProBlock Latex Primer/Sealer.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, flat: S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.
 - d. Topcoat: Latex, exterior, low-sheen: S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - e. Topcoat: Latex, exterior, satin: S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - f. Topcoat: Latex, exterior, semi-gloss: S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - g. Topcoat: Latex, exterior, gloss: S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.
- H. Exterior Gypsum Board Substrates:
- 1. Latex System:
 - a. Prime Coat: Primer, bonding, water-based: S-W PrepRite ProBlock Latex Primer/Sealer.
 - b. Prime Coat: Latex, exterior, matching topcoat.
 - c. Intermediate Coat: Latex, exterior, matching topcoat.
 - d. Topcoat: Latex, exterior, flat: S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.
 - e. Topcoat: Latex, exterior, low-sheen: S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - f. Topcoat: Latex, exterior, satin: S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - g. Topcoat: Latex, exterior, semi-gloss: S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - h. Topcoat: Latex, exterior, gloss: S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.
- I. [Exterior Insulation Finish Systems (EIFS)] [Vinyl Siding]:

1. Latex System:
 - a. First Coat: Latex, exterior, matching topcoat.
 - b. Topcoat: Latex, exterior, flat: S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.
 - c. Topcoat: Latex, exterior, low-sheen: S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - d. Topcoat: Latex, exterior, satin: S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - e. Topcoat: Latex, exterior, semi-gloss: S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - f. Topcoat: Latex, exterior, gloss: S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.

END OF SECTION 09 91 13

SECTION 099123 – INTERIOR PAINTING

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 surface preparation and the application of paint systems on interior substrates.

- 1. Concrete.
- 2. Clay masonry.
- 3. Concrete masonry units (CMU).
- 4. Steel.
- 5. Cast iron.
- 6. Galvanized metal.
- 7. Aluminum (not anodized or otherwise coated).
- 8. Wood.
- 9. Gypsum board.
- 10. Plaster.
- 11. Spray-textured ceilings.
- 12. Cotton or canvas insulation covering.
- 13. ASJ insulation covering.

- B. Related Requirements:

- 1. Section 092900 Gypsum Board Assemblies
- 2. Section 079200 Joint Sealants

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523, a matte flat finish.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, a high-side sheen flat, velvet-like finish.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, an eggshell finish.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523, a satin-like finish.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523, a semi-gloss finish.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523, a gloss finish.

1.4 ACTION SUBMITTALS

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- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, **8 inches (200 mm)** square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. VOC content.

1.5 CLOSEOUT SUBMITTALS

- A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials from the same product run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than **1 gal. (3.8 L)** of each material and color applied.

1.7 QUALITY ASSURANCE

- A. Mockups: Apply mockups 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 in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least **100 sq. ft. (9 sq. m)**.
 - b. 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.

1.8 DELIVERY, STORAGE, AND HANDLING

THE NEWTRON GROUP – NEW CAMPUS HEADQUARTERS

- A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer's label with the following information:
 - 1. Product name and type (description).
 - 2. Batch date.
 - 3. Color number.
 - 4. VOC content.
 - 5. Environmental handling requirements.
 - 6. Surface preparation requirements.
 - 7. Application instructions.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Lead Paint: It is not expected that lead paint will be encountered in the Work.
 - 1. If suspected lead paint is encountered, do not disturb; immediately notify Architect and Owner.
- D. Lead Paint: Lead paint [is] [may be] present in buildings and structures to be painted. A report on the presence of lead paint is on file for review and use. Examine report to become aware of locations where lead paint is present.
 - 1. Do not disturb lead paint or items suspected of containing hazardous materials except under procedures specified.
 - 2. Perform preparation for painting of substrates known to include lead paint in accordance with EPA Renovation, Repair and Painting Rule and additional requirements of authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company products indicated or comparable product from one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Sherwin Williams Co.
 - 3. Behr Corporation
 - 4. Glidden Professional, Division of PPG Architectural Finishes, Inc.
 - 5. PPG Architectural Finishes, Inc.
 - 6. Pratt & Lambert.

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- B. Source Limitations: Obtain paint materials from single source from single listed manufacturer.
 - 1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Dry-Fog Coatings: 400 g/L.
 - 4. Primers, Sealers, and Undercoaters: 200 g/L.
 - 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
 - 8. Floor Coatings: 100 g/L.
 - 9. Shellacs, Clear: 730 g/L.
 - 10. Shellacs, Pigmented: 550 g/L.
- C. Low-Emitting Materials: Interior paints and coatings 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. Colors: As selected by Architect from manufacturer's full range.
 - 1. 10 percent of surface area will be painted with deep tones.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

INTERIOR PAINTING

3.1 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. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
 - 1. Report, in writing, conditions that may affect application, appearance, or performance of paint.
- B. Substrate Conditions:
 - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.
 - c. Wood: 15 percent.
 - d. Gypsum Board: 12 percent.
 - e. Plaster: 12 percent.
 - 2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
 - 3. Plaster Substrates: Verify that plaster is fully cured.
 - 4. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 - 1. Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 03732.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

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- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
 - 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 - 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 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:

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1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 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.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces and Clay Masonry:
 1. Latex System:

- a. Prime Coat: Primer sealer, latex, interior: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - d. Topcoat: Latex, interior, low sheen: S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - e. Topcoat: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - f. Topcoat: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - g. Topcoat: Latex, interior, gloss: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
2. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer sealer, latex, interior: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
3. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."
4. Concrete Stain System (Water-based) for Vertical Surfaces:
- a. First Coat: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).
 - b. Second Coat: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).
- B. Concrete Substrates, Pedestrian Traffic Surfaces:
1. Latex Floor Enamel System:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.
 2. Clear Acrylic System, Gloss Finish:
 - a. First Coat: S-W H&C Concrete Sealer Wet Look Water Base, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).
 - b. Second Coat: S-W H&C Concrete Sealer Wet Look Water Base, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).
 3. Concrete Stain System (Water-based):
 - a. First Coat: Low-luster opaque finish: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).
 - b. Second Coat: Low-luster opaque finish: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).

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4. Epoxy and Urethane Coatings: Refer to Section 099600 "High-Performance Coatings."
5. Epoxy- and Urethane- Based Aggregate-Filled Floor Surfacing: Refer to Section 09 67 23 "Resinous Flooring."

C. CMU Substrates:

1. Latex System:

- a. Block Filler: Block filler, latex, interior/exterior: S-W PrepRite Block Filler, B25W25, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, flat: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- d. Topcoat: Latex, interior, low sheen: S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- e. Topcoat: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
- f. Topcoat: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- g. Topcoat: Latex, interior, gloss: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

2. Water-Based Light Industrial Coating System:

- a. Block Filler: Block filler, latex, interior/exterior: S-W PrepRite Block Filler, B25W25, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, eggshell: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
- d. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

3. Concrete Stain System (Water-based):

- a. First Coat: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).
- b. Second Coat: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).

4. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."

5. Epoxy and Urethane Coatings: Refer to Section 099600 "High-Performance Coatings."

D. Metal Substrates (Aluminum, Steel, Galvanized Steel):

1. Latex System:

- a. Prime Coat: Primer, rust-inhibitive, water based: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.
- b. Intermediate Coat: Water-based acrylic, interior, matching topcoat.
- c. Topcoat: Water-based acrylic, semi-gloss: S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.
- d. Topcoat: Water-based acrylic, gloss: S-W Pro Industrial Acrylic Gloss Coating, B66-660 Series, at 2.5 to 4.0 mils dry, per coat.

2. Water-Based Dry-Fall System:
 - a. Top Coat: Dry-fall latex, flat: S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-80 Series, at 6.0 mils wet, 1.7 mils dry.
 - b. Top Coat: Dry-fall latex, eggshell: S-W Pro Industrial Waterborne Acrylic DryFall Eg-Shel, B42-2 Series, at 6.0 mils wet, 1.9 mils dry.
 - c. Top Coat: Dry-fall latex, semi-gloss: S-W Pro Industrial Waterborne Acrylic DryFall Semi-Gloss, B42-80 Series, at 5.8 mils wet, 2.3 mils dry.
 3. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, rust-inhibitive, water based: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10.0 mils wet, 2.0 to 4.0 mils dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 4. Two-Component Epoxy and Epoxy High Build Systems: Refer to Section 099600 "High-Performance Coatings."
 5. Acrylic/Alkyd System:
 - a. Prime Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10.0 mils wet, 2.0 to 4.0 mils dry.
 - b. Intermediate Coat: Water-based acrylic-alkyd, interior, matching topcoat.
 - c. Topcoat: Water-based acrylic-alkyd, semi-gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Semi-Gloss, B34-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - d. Topcoat: Water-based acrylic-alkyd, gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Gloss, B35-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
- E. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.
1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior: S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils wet, 1.4 mils dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - d. Topcoat: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - e. Topcoat: Latex, interior, gloss: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 2. Acrylic/Alkyd System:
 - a. Prime Coat: Primer sealer, latex, interior: S-W Premium Wall & Wood Primer, B28W8111, at 4.0 mils wet, 1.8 mils dry.
 - b. Intermediate Coat: Water-based acrylic-alkyd, interior, matching topcoat.
 - c. Topcoat: Water-based acrylic-alkyd, semi-gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Semi-Gloss, B34-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - d. Topcoat: Water-based acrylic-alkyd, gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Gloss, B35-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

3. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer sealer, latex, interior: S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils wet, 1.4 mils dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 4. Two-Component Epoxy and Epoxy High Build Systems: Refer to Section 099600 "High-Performance Coatings."
- F. Wood Substrates, Pedestrian Traffic Surfaces:
1. Latex Floor Enamel System:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.
- G. [Gypsum Board] [Plaster] [and] [Spray-Texture Ceiling] Substrates:
1. Latex System:
 - a. Prime Coat: Primer, latex, interior: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - d. Topcoat: Latex, interior, low sheen: S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - e. Topcoat: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - f. Topcoat: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - g. Topcoat: Latex, interior, gloss: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 2. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer sealer, latex, interior: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell: S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 3. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."

END OF SECTION 09 91 23

SECTION 099600 - HIGH-PERFORMANCE COATINGS

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 surface preparation and the application of high-performance coating systems[.][**on the following substrates:**]

- 1. Exterior Substrates:

- a. Concrete, horizontal surfaces.
 - b. Concrete masonry units (CMU).
 - c. Steel.
 - d. Galvanized metal.
 - e. Aluminum (not anodized or otherwise coated).

- 2. Interior Substrates:

- a. Concrete, **[vertical] [and] [horizontal]** surfaces.
 - b. Concrete masonry units (CMU).
 - c. Steel.
 - d. Galvanized metal.
 - e. Aluminum (not anodized or otherwise coated).
 - f. Gypsum board.

- B. Related Requirements:

- 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
 - 2. Section 055213 "Pipe and Tube Railings" for shop **[priming] [painting]** pipe and tube railings with coatings specified in this Section.
 - 3. Section 099113 "Exterior Painting" for special-use coatings and general field painting.
 - 4. Section 099123 "Interior Painting" for special-use coatings and general field painting.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

- 1. Indicate VOC content.

- B. Sustainable Design Submittals:

- 1. Product Data for LEED 2009 Credit EQ 4.2: For paints and coatings, include printed statement of VOC content.

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2. Laboratory Test Reports for LEED 2009 Credit EQ 4.2: For paints and coatings, indicating compliance with requirements for low-emitting materials.
 - C. Samples for Initial Selection: For each type of topcoat product indicated.
 - D. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.
 1. Submit Samples on rigid backing, **8 inches (200 mm)** square.
 2. Label each coat of each Sample.
 3. Label each Sample for location and application area.
 - E. Product List: For each product indicated, include the following:
 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 2. VOC content.
- 1.4 CLOSEOUT SUBMITTALS
- A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.
- 1.5 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Paint: [**1 gal. (3.8 L)**] of each material and color applied.
- 1.6 QUALITY ASSURANCE
- A. Mockups: Apply mockups of each coating system indicated 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 coating system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least **100 sq. ft. (9 sq. m)**.
 - b. 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.

HIGH-PERFORMANCE COATINGS

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1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacture's label with the following information:
1. Product name and type (description).
 2. Batch date.
 3. Color number.
 4. VOC content.
 5. Environmental handling requirements.
 6. Surface preparation requirements.
 7. Application instructions.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F (7 deg C)**.
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between **50 and 95 deg F (10 and 35 deg C)**.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than **5 deg F (3 deg C)** above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
- E. Hazardous Materials: Hazardous materials including lead paint **[are] [may be]** present in buildings and structures to be painted. A report on the presence of known hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
1. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified.
 2. Perform preparation for painting of substrates known to include lead paint in accordance with EPA Renovation, Repair and Painting Rule and additional requirements of authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide [Sherwin-Williams Company \(The\)](#); products indicated or comparable product from one of the following:
1. Benjamin Moore & Co.

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2. Behr Corporation
3. Glidden Professional, Division of PPG Architectural Finishes, Inc.
4. PPG Architectural Finishes, Inc.
5. Pratt & Lambert.

B. Comparable Products: Comparable products of approved manufacturers will be considered in accordance with Section 016000 "Product Requirements," and the following:

1. Products are approved by manufacturer in writing for application specified.
2. Products meet performance and physical characteristics of basis of design product including published ratio of solids by volume, plus or minus two percent.

C. Source Limitations: Obtain paint materials from single source from single listed manufacturer.

1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
3. Provide products of same manufacturer for each coat in a coating system.

B. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC content limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.
4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
5. Floor Coatings: 100 g/L.
6. Shellacs, Clear: 730 g/L.
7. Shellacs, Pigmented: 550 g/L.

C. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Service's "Standard Practice for the Testing of Volatile Organic Chemical Emissions from Various Sources Using Small Scale Environmental Chambers."

D. Colors: **[As selected by Architect from manufacturer's full range]**

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been

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delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 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. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
 1. Report in writing conditions that may affect application, appearance, or performance of paint.
- B. Substrate Conditions:
 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Concrete Masonry: 12 percent.
 - c. Gypsum Board: 12 percent.
 2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
 3. Plaster Substrates: Verify that plaster is fully cured.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

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1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
1. Clean surfaces with pressurized water. Use pressure range of [1500 to 4000 psi (10 350 to 27 580 kPa)] [4000 to 10,000 psi (27 580 to 68 950 kPa)] at 6 to 12 inches (150 to 300 mm).
 2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
- E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content, or alkalinity of surfaces or if alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.
1. Clean surfaces with pressurized water. Use pressure range of [100 to 600 psi (690 to 4140 kPa)] [1500 to 4000 psi (10 350 to 27 580 kPa)] at 6 to 12 inches (150 to 300 mm).
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer[.][**but not less than the following:**]
1. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
 2. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 3. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 4. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
 5. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.
- I. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
1. Use applicators and techniques suited for coating and substrate indicated.
 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

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- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, 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 coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Concrete Substrates, Horizontal Surfaces:
 - 1. Pigmented Polyurethane over Epoxy Slip-Resistant Deck Coating System:
 - a. Prime Coat: Epoxy, gloss:
 - 1) S-W Armorseal 1000 HS, B67W2001 Series, at 3.0 to 5.0 mils (0.076 to 0.127 mm) dry, per coat.
 - b. Intermediate: Polyurethane, gloss matching topcoat.
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss:
 - 1) S-W Armorseal HS Polyurethane, B65W220 Series, at 2.0 to 3.0 mils (0.051 to 0.076 mm) dry, per coat, with manufacturer's recommended slip-resistant aggregate.
- B. CMU Substrates:
 - 1. Pigmented Polyurethane over High-Build Epoxy System:
 - a. Block Filler: Block filler, epoxy:
 - 1) S-W Cement-Plex 875 Acrylic Block Filler B42 Series, at 10 to 20 mils (0.254 to 0.508 mm) dry, per coat.
 - b. Intermediate Coat: Epoxy, high-build, low gloss:

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- 1) S-W Macropoxy 646-100, B58-600 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) dry, per coat.
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss:
 - 1) S-W Pro Industrial Waterbased Acrolon 100 Polyurethane, B65-720 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
- C. Steel Substrates:
1. Pigmented Polyurethane System:
 - a. Prime Coat: Alkyd anti-corrosive, quick dry:
 - 1) S-W Pro-Cryl Universal Primer, B66-310 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
 - b. Intermediate Coat: Polyurethane, two-component, pigmented, matching topcoat.
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss:
 - 1) S-W Pro Industrial Waterbased Acrolon 100 Polyurethane, B65-720 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
 2. Pigmented Polyurethane over Epoxy System:
 - a. Prime Coat: Epoxy, high-build, low gloss:
 - 1) S-W Macropoxy 646-100, B58-600 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) dry, per coat.
 - a. Intermediate Coat: Polyurethane, two-component, pigmented, matching topcoat.
 - b. Topcoat: Polyurethane, two-component, pigmented, gloss:
 - 1) S-W Pro Industrial Waterbased Acrolon 100 Polyurethane, B65-720 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
 3. Pigmented Polyurethane over Epoxy Zinc-Rich Primer System:
 - a. Prime Coat: Primer, zinc-rich, epoxy:
 - 1) S-W Zinc Clad III HS 100, at 3.0 to 5.0 mils (0.076 to 0.127 mm) dry, per coat.
 - b. Intermediate Coat: Epoxy, high-build, low gloss:
 - 1) S-W Macropoxy 646-100, B58-600 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) dry, per coat.
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss:
 - 1) S-W Pro Industrial Waterbased Acrolon 100 Polyurethane, B65-720 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
- D. Galvanized-Metal Substrates:
1. Pigmented Polyurethane over Vinyl Wash Primer System:
 - a. Prime Coat: Primer, vinyl wash:

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- 1) S-W DTM Wash Primer, B71Y1, at 0.7 to 1.3 mils (0.018 to 0.033 mm) dry, per coat.
- b. First Topcoat: Polyurethane, two-component, pigmented, matching topcoat.
- c. Second Topcoat: Polyurethane, two-component, pigmented, gloss:
 - 1) S-W Pro Industrial Waterbased Acrolon 100 Polyurethane, B65-720 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.

E. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Pigmented Polyurethane System:

- a. Prime Coat: Primer, vinyl wash:
 - 1) S-W DTM Wash Primer, at 0.2 to 0.4 mils (0.005 to 0.010 mm) dry, per coat.
- b. First Topcoat: Polyurethane, two-component, pigmented, matching topcoat.
- c. Second Topcoat: Polyurethane, two-component, pigmented, gloss:
 - 1) S-W Pro Industrial Waterbased Acrolon 100 Polyurethane, B65-720 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Epoxy System:

- a. Prime Coat: Epoxy, matching topcoat.
- b. Topcoat: Epoxy, high-build, semi-gloss:
 - 1) S-W Macropoxy 646-100, B58-600 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) dry, per coat.

2. Epoxy-Modified Latex System:

- a. Prime Coat: Epoxy-modified latex, interior, gloss matching topcoat.
- b. Topcoat: Epoxy-modified latex, interior, eggshell:
 - 1) S-W Pro Industrial Waterbased Catalyzed Epoxy Eggshell, B73-300 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
- c. Topcoat: Epoxy-modified latex, interior, gloss:
 - 1) S-W Pro Industrial Waterbased Catalyzed Epoxy Gloss, B73-300 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.

3. Pre-Catalyzed Waterbased Epoxy System:

- a. Prime Coat: Primer sealer, latex, interior:
 - 1) S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

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- c. Topcoat: Epoxy-modified latex, interior, eggshell:
 - 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Eggshell, K45 Series, at 1.5 mils (0.038 mm) dry, per coat.
 - d. Topcoat: Epoxy-modified latex, interior, semi-gloss:
 - 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46 Series, at 1.5 mils (0.038 mm) dry, per coat.
- B. Concrete Substrates, Horizontal Surfaces.
- 1. Epoxy System:
 - a. Prime Coat: Epoxy, matching topcoat.
 - b. Topcoat: Epoxy, Gloss:
 - 1) S-W Armorseal 8100 Water Based Epoxy Floor Coating, B70 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
- C. CMU Substrates:
- 1. Epoxy System:
 - a. Block Filler:
 - 1) S-W Cement-Plex 875 Acrylic Block Filler B42 Series, at 10 to 20 mils (0.254 to 0.508 mm) dry, per coat.
 - b. Intermediate Coat: Epoxy, matching topcoat.
 - c. Topcoat: Epoxy, high-build, semi-gloss:
 - 1) S-W Macropoxy 646-100, B58-600 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) dry, per coat.
 - 2. Epoxy-Modified Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior:
 - 1) S-W Pro Industrial Heavy Duty Block Filler, B42W150, at 10 mils (0.254 mm) dry, per coat.
 - b. Intermediate Coat: Epoxy-modified latex, interior, gloss, matching topcoat.
 - c. Topcoat: Epoxy-modified latex, interior, eggshell:
 - 1) S-W Pro Industrial Waterbased Catalyzed Epoxy Eggshell, B73-300 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
 - d. Topcoat: Epoxy-modified latex, interior, gloss:
 - 1) S-W Pro Industrial Waterbased Catalyzed Epoxy Gloss, B73-300 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
 - 3. Pre-Catalyzed Waterbased Epoxy System:
 - a. Block Filler: Block filler, latex, interior/exterior:

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- 1) S-W Pro Industrial Heavy Duty Block Filler, B42W150Series, at 10 mils (0.254 mm) dry, per coat.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Epoxy-modified latex, interior, eggshell:
 - 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Eggshell, K45 Series, at 1.5 mils (0.038 mm) dry, per coat.
 - d. Topcoat: Epoxy-modified latex, interior, semi-gloss:
 - 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46 Series, at 1.5 mils (0.038 mm) dry, per coat.
- D. Steel Substrates:
1. Epoxy-Modified Latex System:
 - a. Prime Coat: Primer, rust-inhibitive, water based:
 - 1) S-W Pro-Cryl Universal Primer, B66-310 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
 - b. Intermediate Coat: Epoxy-modified latex, interior, gloss matching topcoat.
 - c. Topcoat: Epoxy-modified latex, interior, eggshell:
 - 1) S-W Pro Industrial Waterbased Catalyzed Epoxy Eggshell, B73-300 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
 - d. Topcoat: Epoxy-modified latex, interior, gloss:
 - 1) S-W Pro Industrial Waterbased Catalyzed Epoxy Gloss, B73-300 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
 2. Pre-Catalyzed Waterbased Epoxy System:
 - a. Prime Coat: Primer, rust-inhibitive, water based:
 - 1) S-W Pro-Cryl Universal Primer, B66-310 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Epoxy-modified latex, interior, eggshell:
 - 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Eggshell, K45 Series, at 1.5 mils (0.038 mm) dry, per coat.
 - d. Topcoat: Epoxy-modified latex, interior, semi-gloss:
 - 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46 Series, at 1.5 mils (0.038 mm) dry, per coat.
 3. Pigmented Polyurethane over Epoxy Primer System:
 - a. Prime Coat: Primer, epoxy, anti-corrosive, for metal:

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- 1) S-W Macropoxy 646-100, B58-600 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) dry, per coat.
 - b. Intermediate Coat: Polyurethane, two-component, pigmented, matching topcoat.
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss:
 - 1) S-W Pro Industrial Waterbased Acrolon 100 Polyurethane, B65-720 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
4. Pigmented Polyurethane over Epoxy Zinc-Rich Primer System:
- a. Prime Coat: Primer, zinc-rich, epoxy:
 - 1) S-W Zinc Clad III HS 100, at 3.0 to 5.0 mils (0.076 to 0.127 mm) dry, per coat.
 - b. Intermediate Coat: Primer, epoxy, anti-corrosive, for metal:
 - 1) S-W Macropoxy 646-100, B58-600 Series, B73-620 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) dry, per coat.
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss:
 - 1) S-W Pro Industrial Waterbased Acrolon 100 Polyurethane, B65-720 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
- E. Galvanized-Metal Substrates:
1. Pre-Catalyzed Waterbased Epoxy System:
 - a. Prime Coat: Primer, rust-inhibitive, water based:
 - 1) S-W Pro-Cryl Universal Primer, B66-310 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Epoxy-modified latex, interior, eggshell:
 - 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Eggshell, K45 Series, at 1.5 mils (0.038 mm) dry, per coat.
 - d. Topcoat: Epoxy-modified latex, interior, semi-gloss:
 - 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46 Series, at 1.5 mils (0.038 mm) dry, per coat.
 2. Pigmented Polyurethane System:
 - a. Prime Coat: Primer, vinyl wash:
 - 1) S-W DTM Wash Primer, B71Y1, at 0.7 to 1.3 mils (0.018 to 0.033 mm) dry, per coat.
 - b. Intermediate Coat: Polyurethane, two-component, pigmented, matching topcoat.
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss:
 - 1) S-W Pro Industrial Waterbased Acrolon 100 Polyurethane, B65-720 Series, at 2.0 to 4.0 mils (0.051 to 0.102 mm) dry, per coat.

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F. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Pigmented Polyurethane System:

a. Prime Coat: Primer, vinyl wash:

- 1) S-W DTM Wash Primer, B71Y1, at **0.7 to 1.3 mils (0.018 to 0.033 mm)** dry, per coat.

b. Intermediate Coat: Polyurethane, two-component, pigmented, matching topcoat.

c. Topcoat: Polyurethane, two-component, pigmented, gloss:

- 1) S-W Pro Industrial Waterbased Acrolon 100 Polyurethane, B65-720 Series, at **2.0 to 4.0 mils (0.051 to 0.102 mm)** dry, per coat.

G. [Gypsum Board] [Plaster] Substrates:

1. Epoxy System:

a. Prime Coat: Primer sealer, latex, interior:

- 1) S-W ProMar 200 Zero VOC Interior Latex Primer, B28W2600, at **1.0 mils (0.025 mm)** dry, per coat.

b. Intermediate Coat: Epoxy, gloss matching topcoat.

c. Topcoat: Epoxy, semi-gloss:

- 1) S-W Macropoxy 646-100, B58-600 Series, at **5.0 to 10 mils (0.127 to 0.254 mm)** dry, per coat.

2. Epoxy-Modified Latex System:

a. Prime Coat: Primer sealer, latex, interior:

- 1) S-W ProMar 200 Zero VOC Interior Latex Primer, B28W2600, at **1.0 mils (0.025 mm)** dry, per coat.

b. Intermediate Coat: Epoxy-modified latex, interior, matching topcoat.

c. Topcoat: Epoxy-modified latex, interior, eggshell:

- 1) S-W Pro Industrial Waterbased Catalyzed Epoxy Eggshell, B73-360 Series, at **2.0 to 4.0 mils (0.051 to 0.102 mm)** dry, per coat.

d. Topcoat: Epoxy-modified latex, interior, gloss:

- 1) S-W Pro Industrial Waterbased Catalyzed Epoxy Gloss, B73-300 Series, at **2.0 to 4.0 mils (0.051 to 0.102 mm)** dry, per coat.

3. Pre-Catalyzed Waterbased Epoxy System:

a. Prime Coat: Primer sealer, latex, interior:

- 1) S-W ProMar 200 Zero VOC Interior Latex Primer, B28W2600, at **1.0 mils (0.025 mm)** dry, per coat.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Epoxy-modified latex, interior, eggshell:

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- 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Eggshell, K45 Series, at 1.5 mils (0.038 mm) dry, per coat.
- d. Topcoat: Epoxy-modified latex, interior, semi-gloss:
- 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46 Series, at 1.5 mils (0.038 mm) dry, per coat.

END OF SECTION 099600

SECTION 104413- FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Manufacturer's Product Data Sheets.
2. Material and finish samples.
3. Identification lettering diagram.
4. Manufacturer's literature and data including installation instructions and rough opening requirements. Coordinate cabinet size with fire extinguisher size. Verify that cabinets contain appropriate area to accommodate extinguishers prior to ordering fire extinguisher cabinets.

PART 2 - PRODUCTS

2.1 FIRE-PROTECTION CABINETS AT CORRIDORS

A. Cabinets: Semi-recessed cabinets for fire extinguishers.

1. Manufacturer:

- a. J. L. Industries, 4450 W. 78th St. Circle, Bloomington, MN 55435, Phone: 800-554-6077.
- b. Larsen's Manufacturing Company, 3330 N.W. 17th St. Ft. Lauderdale, FL. 33311, Phone: 800-262-3473, Fax: 954-486-3352.
- c. Approved Equivalent.

B. Cabinet Construction: Nonrated unless otherwise specified on drawings.

1. Form body of cabinet to hold 10 lb. fire extinguisher (see fire extinguisher specification).
2. Design doors to open 180 degrees.
3. Provide lockable doors with full break glass feature. Provide 6 factory cut keys.
4. Provide continuous hinge, pull handle and adjustable roller catch.

C. Cabinet Material: Stainless Steel.

1. Trim Style: Square trim.
2. Trim Material: Stainless Steel.

D. Door Material: Stainless Steel.

1. Door Style: Fully glazed with frame.
2. Door Glazing: Clear wire glass.

E. Accessories: Mounting brackets, factory-applied identification lettering, break glass hammer and chain.

F. Finishes: #4 Satin finish.

PART 3 - EXECUTION

1. INSTALLATION

- a. Install cabinets at same height above finished floor to bottom of cabinet as existing. Mount cabinet with top of cabinet at 5'-0" above finish floor. Verify with Architect before cabinet installation in case of conflict
- b. Identification: Apply identification decals and vinyl lettering at each fire extinguisher cabinet.

END OF SECTION 10 44 13

SECTION 104416 – FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Manufacturer's Product Data Sheets.

1.2 RELATED SECTIONS

- A. Section 079200 Joint Sealants
- B. Section 092900 Gypsum Board Assemblies
- C. Section 099123 Interior Painting
- D. Section 104413 Fire Extinguisher Cabinets

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Manufacturers:

- 1. J. L. Industries, 4450 W. 78th St. Circle, Bloomington, MN 55435, Phone: 800-554-6077.
- 2. Larson's Manufacturing Company, 3330 N.W. 17th St. Ft. Lauderdale, FL. 33311, Phone: 800-262-3473, Fax: 954-486-3352.
- 3. Approved Equivalent.

B. Multipurpose Dry-Chemical Type: UL-rated 4A-80BC, 10-lb nominal capacity, in red colored enameled-steel container.

- 1. Provide as indicated on drawings.

C. Mounting:

- 1. Ensure proper fit in fire extinguisher cabinets provided.
- 2. Bracket mount fire extinguisher in Mechanical Room.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fire extinguishers in cabinets where indicated. Ensure top of fire extinguisher is not more than 5 feet above finish floor. Notify Architect in case of conflict

END OF SECTION 10 44 16

SECTION 10 75 00 - FLAGPOLES

PART 1 GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish and install flagpoles as indicated on the drawings, complete with foundation and accessories.
- B. Related work: concrete and reinforcing steel.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experience in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Section 013030.
- B. Product data: Within 45 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section;
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
 - 3. Shop Drawings showing general layout, dimensions, base design and its connection to foundation, anchoring and support system, and grounding system.
 - 4. Design, calculations, drawings, and other data for foundation design meeting local code requirements. Include details of foundation system.
 - 5. Manufacturers' recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.4 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 016000. Spiral wrap flagpoles with heavy paper and enclose in hard fiber tube or other protective container. Label and submit flags to owner's representative, signed receipt required.

PART 2 PRODUCTS

2.1 FLAGPOLES

- A. Provide flagpoles, accessories, bases, and anchorage devices as complete units furnished by one manufacturer, and with the following attributes:
 - 1. Overall dimensions:
 - One 30 feet high exposed, with 6 inch butt and 3 ½ inch top diameter.
 - Two 25 feet high exposed, with 6 inch butt and 3 ½ inch top diameter.
 - 2. Design:
 - a. Uniform, straight line, cone tapered sections above cylindrical butt sections, aluminum alloy, clear anodized finish all exposed components.
 - b. Cone tapered, ground set with internal halyard system.
 - c. Provide internal splicing, self-aligning sleeve of same material as flagpole for snug fitting, precision field joints.
 - 3. Finish:

- a. Below ground: Shop coat of asphaltic paint inside and outside.
- b. Exposed aluminum surfaces: clear anodized finish on all exposed components.
- B. Fittings and accessories:
 - 1. Provide flash collar of spun or cast aluminum.
 - 2. Provide finial ball 6 inch in diameter of 14 gage aluminum, mount to truck assembly on each flagpole.
 - 3. Provide ball bearing sheaves in revolving non-fouling truck cap.
 - 4. Flags: provide two each of the following, 3x5 foot nominal size sewn nylon with reinforced haylard edge and brass eyes for flag snaps:
 - A. American "Stars and stripes"
 - 5. Flag snaps: satin chrome plated bronze with neoprene covers.
- C. Provide ground set foundation assembly and lightning protection system as standard with the approved manufacturer and as approved by governmental agencies having jurisdiction.
 - 1. Foundation tube: minimum 16 gauge galvanized corrugated steel.
 - 2. Grounding spike: minimum 3/4 diameter steel rod, minimum 6 feet in length, welded to base plate, entire assembly galvanized after fabrication.
- D. Approved manufacturers:
 - 1. American Flagpole Division of Kearney-National, Inc.
 - 2. Acme Flagpoles Company Division of Lingo, Inc.
 - 3. Babcock-Davis Associates, Inc.
 - 4. PoleTech Flagpole Manufacturer
 - 5. Other manufacturers when approved in advance by the Architect.

2.2 FOUNDATIONS

- A. Provide the services of an engineer licensed in the State of Louisiana to perform such work at the location of the Work, and design a foundation for each flagpole to comply with pertinent requirements of governmental agencies having jurisdiction.
- B. Provide such drawings and calculations as are required, and make necessary arrangements and pay such costs as are involved, and secure approvals of governmental agencies having jurisdiction.
- C. Provide labor and materials and perform such services as are needed and construct the foundations in the locations shown on the Drawings and as approved by the Architect and the governmental agencies having jurisdiction.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install the flagpoles and accessories in strict accordance with the manufacturers' recommendations as approved by the Architect, aligning plumb to a vertical tolerance of one in 1000, and adjusting operating components for optimum smoothness of operation.

END OF SECTION – 10 75 00

SECTION 122413 – ROLLER WINDOW SHADES

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. Manually operated roller shades with single rollers. Refer to Window Schedule and Drawings for size and locations.

- B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
- 2. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

- B. Shop Drawings: Show fabrication and installation details for roller shades, including fabric panel materials, their orientation to rollers, and their seam and batten locations.

- C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

- D. Samples for Initial Selection: For each type and color of fabric panel material.

- 1. Include Samples of accessories involving color selection.

- E. Samples for Verification: For each type of roller shade.

- 1. Fabric Panel Material: Not less than 10 inches square. Mark inside face of material if applicable.
- 2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
- 3. Installation Accessories: Full-size unit, not less than 10 inches long.

- F. Roller-Shade Schedule: Use same designations indicated on Drawings.

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1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of fabric panel material, signed by product manufacturer.
- C. Product Test Reports: For each type of fabric panel material, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roller shades to include in maintenance manuals.

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. Roller Shades: Full-size units equal to 20 percent of quantity installed for each size, color, and fabric panel material indicated, but no fewer than two units.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. A firm with the capability to use both knife cutting and ultrasonic cutting in the manufacture of the products required in this Section.
- B. Installer Qualifications: As approved by fabricator of products.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements:

1. Insolroll, Inc., 8 LeRoy Road, Williston, VT 05495; Telephone: 877-797-4630; website: www.insolroll.com
2. Hunter Douglas "Manual and electric roller shades"; Telephone: 800-727-8953; website: www.hunterdouglascontract.com
3. Springs Window Fashions: 8467 Route 405 Highway South P. O. Box 500 Montgomery, PA 17752; Telephone: 877-792-0002; website: www.springswindowfashions.com
4. Or Approved Equal

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch comprised of multi-banded steel springs that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains:

- a. Bead Chain to be #10 stainless steel. Provide upper and lower bead stops to protect shade from over rotation.
- b. Metal Chain Guide Color: Selected from manufacturer's standard available.
- c. Clutch Color: Selected from manufacturer's standard available.
- d. Clutch Holding Capacity: As required by manufacturer for size of shade.
- e. Chain-Retainer Type: Child-safety metal chain guide.

B. Spring Operating Mechanisms: Roller contains spring sized to accommodate shade size indicated. Provide with positive locking mechanism that can stop shade movement at each half-turn of roller and with manufacturer's standard pull.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of fabric panels indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of fabric panels for service.

1. Direction of Fabric Panel Roll: Standard roll.
2. Fabric Panel-to-Roller Attachment: Provide PVC spline heat welded to the shade fabric and inserted into the channel on the roller tube.

- a. Provide fabric panels not less than 12 inches longer than desired shade height to assure solid attachment to roller tube and ability to adjust panels in field without removing mounting brackets.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Fabric Panels:

1. Fabric Panel Material: Light-filtering fabric (TYPE A). Refer to section 2.3 of this specification for fabric panels.

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2. Fabric Panel Bottom (Hem) Bar: Enclosed in hem pocket of fabric panel material, thermally sealed, not sewn.
 - a. Color and Finish: As selected by Architect from manufacturer's full range.

F. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and fabric panel when shade is fully open.
 - c. Color: Selected from manufacturers standard available colors.
2. Endcap Covers: To cover exposed endcaps.
3. Installation Accessories Color and Finish: As selected from manufacturer's full range.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.

2.3 FABRIC PANEL MATERIALS

- A. Fabric Panel Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 1. Basis-of-Design Product: Shear Weave 4400 3%.
 2. Opacity: 3 percent openness.
 3. Certifications:
 - a. Oko-Tek and Greenguard Indoor Air Quality Certified.
 - b. Greenguard Indoor Air Quality Certified for Children and Schools.
 4. Performance Standard:
 - a. Maximum Visual Light Transmission: 3 percent regardless of color.
 5. Color: Selected from manufacturers standards available.

2.4 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

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1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
- C. Fabric Panel Fabrication: Fabricate fabric panels without battens or seams to extent possible except as follows:
1. Vertical Shades: Where width-to-length ratio of fabric panel is equal to or greater than 1:4, provide battens and seams at uniform spacings along fabric panel length to ensure fabric panel tracking and alignment through its full range of movement without distortion of the material.
 2. Skylight Shades: Provide seams at uniform spacings along fabric panel as required to ensure fabric panel tracking and alignment through its full range of movement without distortion or sag of material.
- 2.5 SCHEDULE:
- A. Shades and fabric to be installed at windows as indicated:
1. Refer to Finish Schedule for locations

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER-SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
 1. Opaque Fabric Panels: Located so fabric panel is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 12 24 13

SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

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. Quartz agglomerate surfacing countertops.
2. Quartz agglomerate backsplashes.
3. Quartz agglomerate end splashes.
4. Quartz agglomerate apron fronts.
5. Quartz agglomerate vanities.
6. Quartz agglomerate window sills.
7. Adhesives and sealants.

B. Related Requirements:

1. Section 054000 Cold Form Metal Framing
2. Section 061053 Misc. Rough Carpentry
3. Section 064023 Interior Architectural Woodwork
4. Section 079200 "Joint Sealants".

1.3 REFERENCES

- A. ASTM C 97: Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
- B. ASTM C 170: Standard Test Method for Compressive Strength of Dimension Stone.
- C. ASTM C 501: Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by Taber Abraser.
- D. ASTM C 834: Standard Specification for Latex Sealants.
- E. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
- F. ASTM D 790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- G. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
- H. ISO: International Organization of Standardization.
- I. ISO 9001: Quality Management Systems.
- J. NSF/ANSI Standard 51: Food Equipment Materials.

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- K. SCAQMD Rule 1168: Adhesive and Sealant Applications.
- L. UL 2818: GREENGUARD Certification Program for Chemical Emissions for Building Materials, Finishes, and Furnishings.

1.4 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
 - 1. Submit data for each specified product. Include manufacturer's technical data sheets and published installation instructions.
 - 2. Submit Safety Data Sheets (SDS) for adhesives and sealants.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
- C. Shop Drawings: For countertops. Submit dimensioned shop drawings showing countertop layouts, [backsplashes,] [vanities,] [window sills,] joinery, edge conditions, terminations, substrate construction, cutouts, and holes.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
 - 3. Show plumbing installation provisions.
- D. Samples for Initial Selection: For each type of material exposed to view.
- E. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches (150 mm) square.
 - 2. One full-size quartz agglomerate countertop, with front edge[and backsplash], 8 by 10 inches (200 by 250 mm), of construction and in configuration specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.
- C. Warranty: Submit specimen copy of specified warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Submit manufacturer's published maintenance and care manual. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements

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1. Accessibility Requirements: Comply with the U.S. Architectural & Transportation Barriers Compliance Board ADA-ABA Accessibility Guidelines for Buildings and Facilities.
2. Adhesives, Sealants, and Sealant Primers.
 - a. SCAQMD (South Coast Air Quality Management District) Rule 1168.

- B. Manufacturing Facility Qualifications: Quartz surfacing materials produced in an ISO 9001 certified facility.
- C. Fabricator Qualifications: Minimum of five years documented experience in fabricating quartz surfacing countertops similar in scope and complexity to this Project, using water-cooled cutting tools. Currently certified by the manufacturer as an acceptable fabricator.
- D. Installer Qualifications: Minimum of five years documented installation experience for projects similar in scope and complexity to this Project, and currently certified by the manufacturer as an acceptable installer. [Installer shall be the fabricator.]
- E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 1. Build mockup of typical countertop as shown on Drawings.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's recommendations for shipping and handling quartz surfacing materials to preclude breakage and damage. Brace quartz surfacing units as necessary during shipment, transporting in near-vertical position with finished face towards finished face. Do not allow finished surfaces to rub during shipping and handling.
- B. Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by the manufacturer. Store quartz surfacing sheet materials on racks in near-vertical position to preclude damage. Store with finished face turned towards finished face. Prevent warpage and breakage.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops and openings by field measurements[after base cabinets are installed but] before countertop fabrication is complete. Show recorded measurements on shop drawings.
- B. Adhesives: Acclimate adhesives to occupancy room temperatures with maximum temperature not to exceed 75 deg F (24 deg C).

1.10 COORDINATION

- A. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.
- B. Coordinate locations of utilities that will penetrate countertops or backsplashes.

1.11 WARRANTY

- A. Manufacturer's Limited Warranty: Standard 10 Year Commercial and Residential Limited Warranty against defects in quartz surfacing sheet materials.

QUARTZ AGGLOMERATE COUNTERTOPS

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of up to 93 percent quartz aggregate combined with polyester resin binders and proprietary pigments that are fabricated using vacuum vibrocompaction technology.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Wilsonart; Wilsonart Quartz or a comparable product by one of the following:
 - a. Cambria
 - b. Caesarstone
 - c. Corian
 - d. Or approved equal
 2. Composition: Up to 93 percent quartz aggregate combined with polyester resin binders and proprietary pigments that are fabricated into slabs using Bretonstone vacuum vibrocompaction technology.
 3. Material Thickness: [Product Type 062, 0.79 inch (2 cm)] [Product Type 063, 1.18 inch (3 cm)], nominal.
 4. Material Weight: [10 lb/sq.ft. (48.8 kg/sq. m) for 0.79 inch (2 cm) thick surfacing] [15 lb/sq.ft. (73.2 kg/sq. m) for 1.18 inch (3 cm) thick surfacing].
 5. Countertop Dimensions: [<Insert dimension> inches (<Insert dimension> mm) wide by <Insert dimension> inches (<Insert dimension> mm) deep] [As indicated on Drawings] [As specified in "Schedule" Article of this Section].
 6. Vanity Dimensions: [<Insert dimension> inches (<Insert dimension> mm) wide by <Insert dimension> inches (<Insert dimension> mm) deep] [As indicated on Drawings] [As specified in "Schedule" Article of this Section].
 7. Window Sill Dimensions: [<Insert dimension> inches (<Insert dimension> mm) wide by <Insert dimension> inches (<Insert dimension> mm) deep] [As indicated on Drawings] [As specified in "Schedule" Article of this Section].
 8. Conformance Standards:
 - a. NSF/ANSI Standard 51.
 - b. UL 2818:
 - 1) GREENGUARD, emission levels in UL 2818, Section 7.1 are applicable for furniture products.
 - 2) GREENGUARD Gold, emission levels in UL 2818, Section 7.2 are applicable for building materials, finishes, and furnishings.
 9. Physical Characteristics:
 - a. Flexural Strength: Greater than 4,500 psi (31.0 MPa); ASTM D 790.
 - b. Flexural Strain: Less than 0.375 percent; ASTM D 790.
 - c. Flexural Modulus: Greater than 3.75 MPsi; ASTM D 790.
 - d. Stain resistance (24 Hour): No effect to moderate effect; NEMA LD-3.
 - e. Abrasion Resistance: Greater than 100 in. lbs.; ASTM C 501.
 - f. Density: Greater than 2.1 g/cu. m per ASTM C 97.
 - g. Compressive Strength (One Axis - Div.): Greater than 20,000 psi (138 MPa) per ASTM C 170.
 - h. Moisture Absorption: Less than 0.03 percent per ASTM C 97.
 - i. Surface Burning Characteristics: Class I and Class A per ASTM E 84.
 10. Quartz Finish: Polished finish with Glossometer reading greater than 45.
 11. Colors and Patterns: [As selected from manufacturer's full range of standard offerings].

12. Edge Detail: [Straight] [1/4 inch (6 mm) Radius] [1/2 inch (13 mm) Bullnose] [Demi Bullnose] [Full Bullnose] [1/4 inch (6 mm) Round T&B] [1/4 inch (6 mm) Bevel] [1/2 inch (13 mm) Bevel] [Bevel] [Ogee] [Deep Ogee] [Waterfall] <Insert description>.
13. Edge Detail: [As indicated on Drawings.]

2.2 COUNTERTOP FABRICATION

- A. General: Fabricate components in shop, to greatest extent practicable, in sizes and shapes indicated according to approved shop drawings and Wilsonart Quartz Fabrication manual.
- B. Joint Seams: Form joint seams between quartz surfacing components with specified seam adhesive. Completed joints inconspicuous in appearance and without voids. Provide joint reinforced if required by manufacturer for particular installation conditions.
- C. Cutouts and Holes: Provide holes and cutouts for service fixtures and similar countertop-mounted items as indicated. Form cutouts to required template or pattern, with smooth, even curves and eased edges.
- D. Countertops: [0.78-inch- (2-cm-)] [1.18-inch- (3-cm-)] thick, quartz agglomerate with integral edge.
- E. Backsplashes: [0.78-inch- (2-cm-)] [1.18-inch- (3-cm-)] thick, quartz agglomerate.
- F. End Splash: [Matching backsplash]
- G. Fabricate tops with shop-applied edges[and backsplashes] unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 1. Fabricate with loose backsplashes for field assembly.
- H. Joints: Fabricate countertops without joints.
- I. Joints: Fabricate countertops in sections for joining in field[, with joints at locations indicated].
 1. Joint Locations: Not within 18 inches (450 mm) of a sink or cooktop and not where a countertop section less than 36 inches (900 mm) long would result, unless unavoidable.

2.3 INSTALLATION MATERIALS

- A. Joint Adhesive: Methacrylate-based adhesive for chemically bonding quartz surfacing seams. Color complementary to quartz surfacing sheet material. UL 2818 GREENGUARD Gold certified and complying with SCAQMD Rule 1168.
 1. Basis-of-Design Product: Wilsonart Hard Surface Adhesive.
 2. Adhesives shall have a VOC content of [70] <Insert value> g/L or less.
- B. Elastomeric Sealant: Mildew-resistant silicone sealant for filling gaps between countertops and terminating substrates in wet environment applications. Complies with ASTM C920, Type S (single component), Grade NS (nonsag).
 1. Basis-of-Design Product: Wilsonart; Color Matched Caulk.
 2. Color: [Complementary to quartz surfacing color]
- C. Siliconized Acrylic Sealant: Siliconized acrylic latex sealant. For general applications to fill gaps between countertops and at terminating substrates. Complies with ASTM C 384, Type OP, Grade NF, and SCAQMD Rule 1168.

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1. Basis-of-Design Product: Wilsonart; Color Matched Caulk.
 2. Color: [Complementary to quartz surfacing color]
- D. Construction Adhesive: Countertop manufacturer's recommended silicone-based construction adhesive for backsplashes, endsplashes, and other applications according to manufacturer's published fabrication instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops. Substrates must be sound, flat, smooth, and free from dust or other surface contaminants.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 COUNTERTOP [AND VANITY] INSTALLATION

- A. Install quartz surfacing components plumb, level, and true according to approved shop drawings and manufacturer's published installation instructions. Use woodworking and specialized fabrication tools acceptable to the manufacturer.
 1. Fasten quartz surfacing components to base cabinets or other supporting substrates with suitable adhesives acceptable to manufacturer.
- B. Form joint seams with specified seam adhesive. Seams to be inconspicuous in completed work. Seams in locations shown on approved shop drawings and acceptable to manufacturer. Promptly remove excess adhesive.
 1. Clamp or brace quartz surfaces in position until adhesive sets.
- C. Fill gaps between countertop and terminating substrates with specified silicone sealant.
- D. Install backsplashes and endsplashes where indicated on Drawings. Adhere to countertops with specified construction adhesive.
- E. Vanities: Secure front panels to solid substrate with specified construction adhesive.
 1. ADA Vanities: Angled front to permit wheelchair access to comply with referenced accessibility standard.

3.3 WINDOW SILL INSTALLATION

- A. Install window sills for full length of each window unit, securing to substrates with concealed fasteners and specified adhesives.
- B. Provide minimum **1/8 inch (3.2 mm)** expansion gap on both sides of window sills. Fill gap with specified joint sealant.
- C. Completed work to be plumb, level, and true, with edges eased and smooth.

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3.4 REPAIRS

- A. If permissible to Architect, minor surface marring for quartz surfacing components may be repaired according to manufacturer's published installation instructions.
- B. Remove and replace quartz surfacing components that are damaged and cannot be satisfactorily repaired.

3.5 CLEANING AND PROTECTION

- A. Clean quartz surfacing components according to manufacturer's published maintenance instructions.
- B. Completely remove excess adhesives and sealants from finished surfaces.
- C. Protect completed work from damage during remainder of construction period.

3.6 SCHEDULE

END OF SECTION 123661.19

SECTION 142400- MACHINEROOM-LESS HYDRAULIC PASSENGER ELEVATORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Machine room-less hydraulic passenger elevators as shown and specified. Elevator work includes:
1. Standard pre-engineered hydraulic passenger elevators.
 2. Elevator car enclosures, hoistway entrances and signal equipment.
 3. Operation and control systems.
 4. Jack(s).
 5. Accessibility provisions for physically disabled persons.
 6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
 7. Materials and accessories as required to complete the elevator installation.
- B. Related Sections:
1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
 2. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
 3. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
 4. Division 5 Metals:
 - a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
 - b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
 5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
 6. Division 16 Sections:
 - a. Providing electrical service to elevators, including fused disconnect switches where permitted. (note: fused disconnect switch to be provided as part of elevator manufacture product, see section 2.11 Miscellaneous elevator components for further details.)
 - b. Emergency power supply, transfer switch and auxiliary contacts.
 - c. Heat and smoke sensing devices.
 - d. Convenience outlets and illumination in control room (if applicable), hoistway and pit.
 7. Division 22 Plumbing
 - a. Sump pit and oil interceptor.
 8. Division 23 Heating, Ventilation and Air Conditioning
 - a. Heating and ventilating hoistways and/or control room.
- C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Part 3 for hydraulic elevators. State or local requirements must be used if more stringent. The cost of this work is not included in the TK Elevator's proposal, since it is a part of the building construction.
1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.
 2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.
 3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.

4. Elevator hoistways shall have barricades, as required.
5. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.
8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
9. All wire and conduit should run remote from the hoistways.
10. When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12 volt D.C.
11. Install and furnish finished flooring in elevator cab.
12. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.
13. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.
14. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
15. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
16. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
17. General Contractor shall fill and grout around entrances, as required.
18. All walls and sill supports must be plumb where openings occur.
19. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.
20. Provide telephone line, light fixture (200 lx / 19 fc), and convenience outlet in the hoistway at the landing where the elevator controller is located. Typically this will be at the landing above the 1st floor. Final location must be coordinated with elevator contractor.
21. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway.
22. For signal systems and power operated door: provide ground and branch wiring circuits.
23. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.
24. Controller landing wall thickness must be a minimum of 8 1/2 inches thick. This is due to the controller being mounted on the second floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). These requirements must be coordinated between the general contractor and the elevator contractor.
25. Cutting, patching and recesses to accommodate hall button boxes, signal fixtures, etc..

1.02 SUBMITTALS

- A. Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.
- B. Shop drawings:
 1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.

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2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
 3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
 4. Indicate electrical power requirements and branch circuit protection device recommendations.
- C. Powder Coat paint selection: Submit manufacturer's standard selection charts for exposed finishes and materials.
- D. Plastic laminate selection: Submit manufacturer's standard selection charts for exposed finishes and materials.
- E. Metal Finishes: Upon request, standard metal samples provided.
- F. Operation and maintenance data. Include the following:
1. Owner's manuals and wiring diagrams.
 2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.
1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.
 - a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.
 2. The manufacturer shall have a documented, on-going quality assurance program.
 3. ISO-9001:2000 Manufacturer Certified
 4. ISO-14001:2004 Environmental Management System Certified
 5. LEED Gold certified elevator manufacturing facility.
- B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.
- C. Regulatory Requirements:
1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
 2. Building Code: National.
 3. NFPA 70 National Electrical Code.
 4. NFPA 80 Fire Doors and Windows.
 5. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
 6. Section 407 in ICC A117.1, when required by local authorities
 7. CAN/CSA C22.1 Canadian Electrical Code
 8. CAN/CSA B44 Safety Code for Elevators and Escalators.
 9. California Department of Public Health Standard Method V1.1–2010, CA Section 01350
- D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).
- E. Inspection and testing:

1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
2. Arrange for inspections and make required tests.
3. Deliver to the Owner upon completion and acceptance of elevator work.

F. Sustainable Product Qualifications:

1. Environmental Product Declaration:
 - a. GOOD: If Product Category Rules (PCR) are not available, produce a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
 - b. BEST: If Product Category Rules (PCR) are available, produce and publish an Environmental Product Declaration (EPD) based on a critically reviewed life-cycle assessment conforming to ISO 14044, with external verification recognized by the EPD program operator.
2. Material Transparency:
 - a. GOOD: Provide Health Product Declaration at any level
 - b. BETTER: Provide Health Product Declaration (HPD v2 or later). Complete, published declaration with full disclosure of known hazards, prepared using the Health Product Declaration Collaborative's "HPD builder" on-line tool.
 - c. BEST: Cradle to Cradle Material Health Certificate v3, Bronze level or higher.
3. LEED v4 – Provide documentation for all Building Product Disclosure AND Optimization credits in LEED v4 for product specified.
4. Living Building Challenge Projects: Provide Declare label for products specified.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Manufacturing shall deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.05 PROJECT CONDITIONS

- A. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

1.06 WARRANTY

- A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after final acceptance.

1.07 MAINTENANCE

- A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.
 1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
 2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
 3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Design based around TK Elevator's endura Machine Room-Less hydraulic elevator.

2.02 MATERIALS, GENERAL

- A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1–2010, CA Section 01350 as mentioned in 1.03.9 of this specification.
- B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.
- C. Steel:
 - 1. Shapes and bars: Carbon.
 - 2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
 - 3. Finish: Factory-applied powder coat for structural and architectural parts. Color selection must be based on elevator manufacture's standard selections.
- D. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be based on elevator manufacture's standard selections.
- E. Flooring by others.

2.03 HOISTWAY EQUIPMENT

- A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.
- B. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.
- C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.
- D. Guides: Slide guides shall be mounted on top and bottom of the car.
- E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
- F. Jack: A jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to ensure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless. Two jacks piped together, mounted one on each side of the car with a polished steel hydraulic plunger housed in a sealed steel casing having sufficient clearance space to allow for alignment during installation. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. Each Jack Assembly shall have a check valve built into the assembly to allow for automatically re-syncing the two plunger sections by moving the jack to its fully

contracted position. The jack shall be designed to be mounted on the pit floor or in a recess in the pit floor. Each jack section shall have a bleeder valve to discharge any air trapped in the section..

- G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.
- H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper grade inherently biodegradable oil as specified by the manufacturer of the power unit (see Power Unit section 2.04.G for further details)
- I. Pit moisture/water sensor located approximately 1 foot above the pit floor to be provided. Once activated, elevator will perform "flooded pit operation", which will run the car up to the designated floor, cycle the doors and shut down and trip the circuit breaker shunt to remove 3 phase power from all equipment, including pit equipment.
- J. Motorized oil line shut-off valve shall be provided that can be remotely operated from the controller landing service panel. Also a means for manual operation at the valve in the pit is required.

2.04 POWER UNIT

- A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit located in the elevator pit consisting of the following items:
 - 1. NEMA 4/Sealed Oil reservoir with tank cover including vapor removing tank breather
 - 2. An oil hydraulic pump.
 - 3. An electric motor.
 - 4. Electronic oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.
- B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.
- C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating – motors shall be capable of 80 starts per hour with a 30% motor run time during each start.
- D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
 - 1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
 - 2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
 - 3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
 - 4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.

5. Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.
6. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.
7. A secondary hydraulic power source (powered by 110VAC single phase) must be provided. This is required to be able to raise (reposition) the elevator in the event of a system component failure (i.e. pump motor, starter, etc.)
8. Oil Type: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially those operating in environmentally sensitive areas.

2.05 HOISTWAY ENTRANCES

- A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
 1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.
 2. Main landing door & frame finish: Stainless steel panels, no. 4 brushed finish with no. 4 brushed finish entrance frame.
 3. Typical door & frame finish: Stainless steel panels, no. 4 brushed finish with no. 4 brushed finish entrance frame.
- B. Integrated Control System: the elevator controller to be mounted to hoistway entrance above 1st landing. The entrance at this level, shall be designed to accommodate the control system and provide a means of access to critical electrical components and troubleshooting features. See section 2.09 Control System for additional requirements.
- C. At the controller landing, the hoistway entrance frame shall have space to accommodate and provide a lockable means of access (group 2 security) to a 3 phase circuit breaker. See section 2.11 Miscellaneous Elevator Components for further details
- D. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.
- E. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
 1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
 2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
 3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.
- F. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.06 PASSENGER ELEVATOR CAR ENCLOSURE

- A. Car Enclosure:
 1. Walls: Cab type TKAP, reinforced cold-rolled steel with two coats factory applied baked enamel finish, with applied vertical wood core panels covered on both sides with high pressure plastic laminate.
 2. Reveals and frieze: a. Reveals and frieze: Stainless steel, no. 4 brushed finish
 3. Canopy: Cold-rolled steel with hinged exit.

4. Ceiling: Suspended type, LED lighting with translucent diffuser mounted in a metal frame. Framework shall be finished with a stainless steel, no. 4 brushed finish.
 5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel
 6. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
 - a. Door Finish: Stainless steel panels: No. 4 brushed finish.
 - b. Cab Sills: Extruded aluminum, mill finish.
 7. Handrail: Provide 1.5' diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.
 8. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.
 9. Protection pads and buttons: Not required
- B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.07 DOOR OPERATION

- A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.
1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
 2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
 3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.
 4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.
 5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
 6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.

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7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.
 8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.
- B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.08 CAR OPERATING STATION

- A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Wrap return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.
- B. Emergency Communications System: Integral phone system provided.
- C. Auxiliary Operating Panel: Not Required
- D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.
- E. Special Equipment: Not Applicable

2.09 CONTROL SYSTEMS

- A. Controller: Shall be integrated in a hoistway entrance jamb. Should be microprocessor based, software oriented and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.
- B. Service Panel – to be located outside the hoistway in the controller entrance jamb and shall provide the following functionality/features:
1. Access to main control board and CPU
 2. Main controller diagnostics
 3. Main controller fuses
 4. Universal Interface Tool (UIT)
 5. Remote valve adjustment
 6. Electronic motor starter adjustment and diagnostics
 7. Operation of pit motorized shut-off valve with LED feedback to the state of the valve in the pit
 8. Operation of auxiliary pump/motor (secondary hydraulic power source)
 9. Operation of electrical assisted manual lowering

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10. Provide male plug to supply 110VAC into the controller
 11. Run/Stop button
- C. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.
- D. Emergency Power Operation: (10-DOA) Upon loss of the normal power supply, building-supplied standby power is available on the same wires as the normal power supply. Once the loss of normal power is detected and standby power is available, the elevator is lowered to a pre-designated landing and the doors are opened. After passengers have exited the elevator, the doors are closed and the car is shut down. When normal power is restored, the elevator automatically resumes operation.
- E. Special Operation: Not Applicable

2.10 HALL STATIONS

- A. Hall Stations, General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.
1. Provide one pushbutton riser with faceplates having a brushed stainless steel finish.
 - a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.
- B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.
- C. Hall Position Indicator: Not Applicable
- D. Hall lanterns: Not Applicable
- E. Special Equipment: Not Applicable

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

- A. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.
- B. Lockable three phase circuit breaker with auxiliary contact with shunt trip capability to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb and should be sized according to the National Electrical Code.
- C. Lockable single phase 110V circuit breaker for cab light and fan to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb should be sized according to the National Electrical Code

PART 3 EXECUTION

3.01 EXAMINATION

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- A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

- A. Install elevator systems components and coordinate installation of hoistway wall construction.
 - 1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
 - 2. Comply with the National Electrical Code for electrical work required during installation.
- B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.
- C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.
- D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.
- E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.
- F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.
- G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
- H. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.
- I. Lubricate operating parts of system, where recommended by manufacturer.

3.03 FIELD QUALITY CONTROL

- A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

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- B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

- A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

- A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.
- B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
 - 1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.06 PROTECTION

- A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
- B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.08 ELEVATOR SCHEDULE

- A. Elevator Qty. 1
 - 1. Elevator Model: endura MRL Twinpost above-ground 1-stage
 - 2. Elevator Type: Hydraulic Machine Room-Less, Passenger
 - 3. Rated Capacity: 3500 lbs.
 - 4. Rated Speed: 150 ft./min.
 - 5. Operation System: TAC32H
 - 6. Travel: 16'-11"
 - 7. Landings: 2 total
 - 8. Openings:

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- a. Front: 2
- b. Rear: 0
- 9. Clear Car Inside: 6'-8" wide x 5'-5" deep
- 10. Inside clear height: 7'-4" standard
- 11. Door clear height: 7'-0" standard
- 12. Hoistway Entrance Size: 3'-6" wide x 7'-0" high
- 13. Door Type: One-speed Center opening
- 14. Power Characteristics: 208 volts, 3 Phase, 60 Hz. (VERIFY WITH MANUFACTURER FOR REQUIREMENTS PRIOR TO CONSTRUCTION)
- 15. Seismic Requirements: No
- 16. Hoistway Dimensions: 8'-4" wide x 6'-11" deep
- 17. Pit Depth: 4'-0"
- 18. Button & Fixture Style: Traditional Signal Fixtures
- 19. Special Operations: None

3.09 SPECIAL CONDITIONS

END OF SECTION

Section 21 13 13 - Wet Pipe Sprinkler Systems.

PART 1 GENERAL

1.1 SCOPE

- A. Requirements of Section 01 including, but not limited to, General Requirements, Submittal Procedures, Quality Requirements, Product Requirements, Substitution Procedures, Operation and Maintenance Data, Demonstration and Training shall apply to all work under this section.
- B. Provide labor and materials, tools and appliances, and miscellaneous accessories to provide a complete operating automatic sprinkler system throughout the building as shown on drawings and as required by the National Fire Protection Association and the currently adopted codes and ordinances.
- C. Coordinate all tamper switches, flow switches, pull stations, smoke detector, etc. with fire alarm contractor. Refer to Section 28 3111 for electrical work associated with this Section.
- D. All sprinkler piping shall be concealed in the building. Where concealment is not feasible, coordinate painting of pipe with architect.

1.2 SYSTEM DESCRIPTION

- A. The Sprinkler System shall provide coverage for the entire building. Switches for alarm and supervision shall be provided and coordinated with the Fire Alarm Contractor for transfer to the supervising station.
- B. The entire facility is to be protected by a wet pipe system. Design density to be in accordance with NFPA 13 and as indicated on the plans.
- C. The Contractor shall conduct a fire hydrant flow test as a basis for hydraulically calculated systems. The test shall be within 1 year from date of fire protection system submittal submission.
- D. This project will include cloud ceilings and protection of them in accordance with NFPA 13 shall be fully documented on the shop drawings.

1.3 SUBMITTALS

- A. Submittals: Submit shop drawings, product data and hydraulic calculations to Architect/Engineer for submittal to the authority having jurisdiction, and the State Fire Marshal for approval.
- B. Shop Drawings: Indicate detailed pipe layout, supports, components, accessories, sizes and hydraulic calculations.
- C. Product Data: Provide data for pipe materials used, valves, manufacturer's fully annotated catalogue sheet for equipment,
- D. Operation and Maintenance Instructions: Include components of system, servicing requirements, Record Drawings, inspection data and parts lists.
- E. Extra Materials: Provide extra sprinkler heads per NFPA requirements for each type of sprinkler, wrenches and metal storage cabinet adjacent to the riser.
- F. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements.

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- G. Any permits for the installation or construction of all work included in this section which are required by any of the authorities and/or agencies having jurisdiction shall be obtained and paid for by the Contractor.

1.4 QUALITY ASSURANCE

- A. Sprinkler Systems: Conform to NFPA 13 – 2019 Edition.
- B. Fire Main: Conform to NFPA 24 – 2019 Edition.
- C. Equipment and Components: Bear UL or FM label or marking.
- D. Specialist Firm: Company specializing in fire sprinkler protection systems whose supervisory personnel have a minimum of five years' experience.
- E. Design: Under direct supervision of a minimum of a NICET Level III designer.
- F. Drawings are diagrammatic. Obtain approval of the reviewing authority before installing any part of the system. Contractor's bid shall be based on the hydraulically calculated submission to the State Fire Marshal. Comply with all codes and regulations including:
 - 1. City and State Fire Marshal.
 - 2. National Fire Protection Association (NFPA)
 - 3. Local codes and ordinances.

1.5 ELECTRICAL

- A. Electrical flow switches and supervisory switches and other electrical devices provided under this section shall be installed by the sprinkler contractor and coordinated with the fire alarm contractor.

1.6 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect fire sprinkler system materials before, during and after installation and protect the installation work of all other trades.
- B. Suitable storage space as required shall be provided by the Owner to the Contractor. This space shall be agreed upon by the Owner and the Contractor prior to storage thereon.
- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 PIPE AND TUBE

- A. Steel Pipe: ASTM A53, ASTM A120, ANSI/ASTM A135, or ANSI/ASME B36.10, Schedule 40 black or galvanized.
 - 1. Steel Fittings:
- B. ANSI/ASME B16.9, wrought steel, butt welded; ANSI/ASME B16025, butt weld ends; ASTM A234, wrought carbon steel and alloy steel; ANSI/ASME B16.5, steel flanges and fittings; ANSI/ASME B16.11, forged steel socket welded and threaded.
 - 1. Cast Iron Fittings:
- C. ANSI/ASME B16.1, flanges and fittings; ANSI/ASME16.4, screwed fittings.

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1. Malleable Iron Fittings: ANSI/ASME B16.3, screwed type; ANSI/ASTM A47.
2. Mechanical Grooved Couplings:

- D. Malleable iron housing, "C" shaped composition sealing gasket, steel bolts, nuts and washers; galvanized for galvanized pipe.
- E. All piping shall be securely fastened with UL approved hangers and hangers shall be in no case greater than twelve (12) feet apart. Every branch line length of pipe, except lengths less than eighteen (18) inches, shall have at least one hanger. Pipes shall be hung as follows: 1-1/4" @ 8'-0" on center, 1-1/2" to 3" @ 10'-0" on center, 4" to 8" @ 12'-0" center, and/or as required by NFPA 13.

2.2 GATE VALVES

- A. Up to and Including 2 Inches: Bronze body, body trim, rising stem, handwheel, inside screw, solid wedge or disc, solder or threaded ends.
- B. Over 2 inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, solid wedge, flanged or grooved ends.

2.3 BUTTERFLY VALVES

- A. Bronze body, stainless steel disc, resilient replaceable seat, threaded ends, extended neck, handwheel and gear drive and integral indicating device and built-in tamper switch.
- B. Cast or ductile iron body, chrome plated ductile iron disc, resilient replaceable EPDM seat, wafer or lug ends, extended neck, handwheel and gear drive and integral indicating device and built-in tamper proof switch.

2.4 CHECK VALVES

- A. Up to and including 2 inches: Bronze swing disc, solder or screwed ends.
- B. Over 2 inches: Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends with bolted inspection plate.
- C. Iron body, bronze trim, stainless steel spring, renewable composition disc, screwed, wafer or flanged ends.

2.5 DRAIN VALVES

- A. Bronze compression stop with nipple and cap or hose thread.
- B. Brass ball valve.

2.6 SPRINKLER HEADS

- A. Suspended Ceiling Type: Pendant type with chrome plated finish and matching escutcheon, as indicated on the drawings.
- B. Exposed Area Type: Upright type with brass finish, as indicated on the drawings

2.7 SPRINKLER PIPING SPECIALTIES

- A. Riser Control Valves: Riser control valve, butterfly valve with integral supervisory switch.
- B. Waterflow Bell: 24-volt, 6-inch alarm bell, coordinate with fire alarm contractor.

- C. Flow Switches: Vane type with retard.
- D. Zone Control Valves: Sprinkler zone control valves, butterfly valve with integral supervisory switch.
- E. Pressure Gauges: Approved 2-1/2" bronze Bourdon tube, Polycarbonate glass window in black steel case with brass cock. Select so normal pressure reads at center scale.
- F. Hangers and Supports:
 - 1. Individual hangers - Adjustable swivel ring, steel, zinc plated with rod secured to bracket screwed to beam.
 - 2. Riser clamps, 2-part steel, secured with 2 bolts, sized to clamp tight to pipe, wall supports, steel angle bracket secured to wall with hangers as above.
 - 3. All hangers and supports shall be UL approved.

2.8 FIRE DEPARTMENT CONNECTION

- A. Type: Flush mounted wall type with brass finish.
- B. Outlets: Two-way thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish with individual clappers.
- C. Drain: Automatic drip, to outside.

PART 3 EXECUTION

3.1 HYDRAULIC CALCULATIONS

- A. Contractor shall hydraulically calculate the sprinkler system. Calculation should be submitted at the same time as the shop drawings.

3.2 SURFACE CONDITIONS

- A. Inspection:
 - 1. Prior to commencement of each stage of the fire sprinkler system installation, carefully inspect the installed work of all other trades and verify that all such work is completed and correct to the point where this installation may properly commence.
 - 2. Avoid interferences with air conditioning ducts, lights, and mechanical and electrical piping and equipment. It is not the intent of drawings to show clearances.

3.3 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions and in strict accordance with all pertinent codes and regulations of the Authority Having Jurisdiction.
- B. Ream pipe and tube ends to full inside diameter. Remove burrs and bevel plain end ferrous pipe.
- C. Remove scale and foreign material, inside and outside, before assembly.
- D. Provide sleeves when penetrating footings and floors. Seal pipe and sleeve penetrations to maintain fire resistance equivalent to fire separation required. An approved fire-resistant compound shall be used.

- E. Where any pipe or riser passes through walls, partitions, floors or ceilings, use chrome plated escutcheon plates. Plates shall be large enough to completely close the hole around the pipes and shall be round with the least dimension not less than 1-1/2" larger than the diameter of the pipe; caulk and secure in a manner approved by the Architect.
- F. Place pipe runs to minimize obstruction to other work. Place piping in concealed spaces above finished ceilings.
- G. Provide valves for shut-off or isolating service. Where approved, use butterfly valves instead of gate valves.
- H. Install main drains on main risers and auxiliary drains at low points in the system in accordance with NFPA 13.
- I. Install inspector's test/drains on each sprinkler system zone per NFPA 13. Drain valves to be of the angle type. Install in accordance with NFPA 13. Pipe drain valves to a safe place of discharge, visible either by open end drain pipe or sight drain fitting.
- J. Install air vents on each zone at the highest location of that zone.
- K. Identification signs shall be provided for all control valves, drains, test valves and other items required by NFPA. These signs shall indicate, identify use and/or purpose of each item provided with said sign. The sign for the siamese connection shall read: "AUTO-SPRINKLER". Signs at test valves and auxiliary drains shall indicate which system they are a part of. Each system shall be given a numerical designation which will be displayed at the riser serving same and all signs for components on each system shall indicate system number.
- L. Upon completion of the sprinkler system installation, furnish all personnel and equipment required to test and re-test the completed system. Make all adjustments necessary to secure the approval of the Authority Having Jurisdiction. All piping to sprinkler heads shall be tested hydrostatically at the pressure of 200 psi for two (2) hours in accordance with NFPA 13. Notify Architect at least twenty-four (24) hours prior to the time of the test. Test shall be witnessed by Owner's Representative.

3.4 CLEANING

- A. When all work has been finally tested, Contractor shall clean all areas and spaces affected by his work.
- B. All finished, exposed products shall be thoroughly cleaned and/or polished.
- C. All piping shall be free from all obstructions.
- D. All crates, rubbish, etc., that is a result from this work shall be removed from the area on a daily basis.

3.5 ACCEPTANCE

- A. After the fire sprinkler system has been completely approved, secure a letter of final acceptance from the Authority Having Jurisdiction and submit to the Architect.

3.6 GUARANTEE

- A. Guarantee all materials and work for one year from the date of acceptance as defined by Louisiana Law. See "General conditions".

END OF SECTION 21-00-00

Hangers and Supports for Plumbing Piping and Equipment

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

SECTION 22 05 29 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 PROVISIONS

- A. Requirements of Section 01 including, but not limited to, General Requirements, Submittal Procedures, Quality Requirements, Product Requirements, Substitution Procedures, Operation and Maintenance Data, Demonstration and Training shall apply to all work under this section.
- B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition.

1.2 DESCRIPTIONS

- A. Work covered by this Section includes furnishing of and paying for all materials, labor, services, equipment, licenses, taxes, other items, and appliances necessary for the execution, installation and completion of all work specified herein and/or shown on the drawings.
- B. The work described in this section of the specifications includes but is not limited to the following:
 - 1. Pipe hangers for various types of pipe installed as set forth in this section and related sections.
 - 2. All intermediate support steel attached to building structure for piping systems as necessary for support of all piping systems.
- C. Piping shall be isolated from hanger material supports and different piping material shall be suitably isolated to prevent galvanic corrosion or deterioration resulting from contact of dissimilar metals.

1.3 RELATED WORK

- A. The following items of related work are specified and included in other sections of these operations from contact of dissimilar metals:
 - 1. Section 23 0516 - Piping and Fittings
 - 2. Section 23 0719 - Mechanical System Insulation

PART 2 PRODUCTS

2.1 APPLICABLE PUBLICATION

- A. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc. Publication are referenced in the text by the basic designation only.
 - 1. SP-58-93: Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. SP-69-91: Pipe Hangers and Supports - Selection and Application.

2.2 2.2 HANGERS

- A. Pipe hangers and supports. Adjustable clevis hangers for:
 - 1. Non-insulated pipe 2" through 24" diameter.
- B. Pipe hangers and supports. Adjustable wrought clevis hangers, with SP-58, MSS Type 40 galvanized insulation protection shields (sized for supporting insulation having a compressive strength of 4 psi, at 8-foot intervals). Support piping on outside of insulation. Size hangers so that pipe insulation passes through them without interruption. Use these for:
 - 1. Insulated steel pipe 1/2" through 24" diameter.
 - 2. Insulated copper pipe 1/2" through 8" O.D.
- C. MSS SP-58 Type 6, with adjustable swivel ring, split ring type for:
 - 1. Non-insulated steel pipe, copper pipe 1/2" through 1-1/2" diameter.
- D. MSS SP-58 Type 9, with adjustable wrought tubing ring hanger, either plastic covered or copper plated for non-insulated copper tubing with no longitudinal movement.
- E. MSS SP-58 Type 41 with pipe roller and MSS SP-58 Type 40 galvanized insulation protection shields (sized for supporting insulation having a compressive strength of 4 psi, at 8-foot intervals). Support piping on outside of insulation. Size hangers so that pipe insulation passes through them without interruption. Use these for:
 - 1. Insulated copper pipe, 1/2" through 2-1/8" diameter, having longitudinal movement.
 - 2. Insulated steel pipe, 1" through 30" diameter, having longitudinal movement.
- F. MSS SP-58 Type 8, riser clamps (at floor slab penetrations) to support copper pipe risers.
- G. MSS SP-58 Type 8, riser clamps (at floor slab penetrations) to support steel pipe risers.
- H. Where three or more lines of pipe run parallel, support them with trapeze hangers.

PART 3 EXECUTION

3.1 PIPE HANGERS

- A. Support pipes on specified hangers so that equipment, pumps, and fittings do not bear weight of pipe.
 - 1. Support pipe risers at regular intervals in pipe shafts in accordance with good practice.
 - 2. Do not use perforated metal, strap iron, or band iron.
 - 3. Do not make offsets in hangers.
- B. Maximum allowable spacing of pipe hangers is listed below. Space hangers and brackets at close intervals where necessary to maintain levels, slopes, and drainage, or to prevent sagging.
- C. Steel Pipe:
 - 1. 1/4" to 3/4" - 6'-0" o.c.
 - 2. 1" to 12" - 10'-0" o.c.
 - 3. 3/8 to 1 1/4" - 7'-0" o.c.

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4. 1 ½ to 2" – 9'-0" o.c.
5. 2 ½ to 3" – 11'-0" o.c.
6. 4" – 14'-0" o.c.
7. 5" to 6" – 16'-0" o.c.
8. 8" – 19'-0" o.c.
9. 10" – 22'-0" o.c.

D. Copper Pipe:

1. 1/2" to 3/4" – 5'-0" o.c.
2. 1" to 1-1/4" – 6'-0" o.c.
3. 1 ½" to 2" – 8'-0" o.c.
4. 2 ½" – 9'-0" o.c.
5. 3" – 10'-0" o.c.
6. 4" – 12'-0" o.c.
7. 6" – 14'-0" o.c.
8. 8" – 16'-0" o.c.

END OF SECTION 22-05-29

Identification for Plumbing Piping and Equipment

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
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SECTION 22 05 53 – IDENTIFICATION FOR PLUMBING, PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Equipment signs.
 - 4. Access panel and door markers.
 - 5. Pipe markers.
 - 6. Valve tags

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Certain items in this Specification are listed by manufacturer and/or manufacturer's model number to establish general style, type, character and quality of the product desired. Similar items manufactured by other than those listed will be considered, providing submittals are made according to Pre-Bid Approval requirements of Instructions to Bidders.
- B. Where no manufacturer or model number are given, any product meeting performance or design criteria, or referenced trade association standard may be used and Pre-Bid Approval is not required.
- C. Manufacturers: Subject to compliance with requirements for complete systems provide products of one of the following:

2.2 EQUIPMENT IDENTIFICATION DEVICE

- A. Equipment Nameplates: Stainless Steel, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:

- a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 2. Location: Accessible and visible.
 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
1. Terminology: Match schedules as closely as possible.
 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Data: Instructions for operation of equipment and for safety procedures.
 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 3. Thickness: 1/8 inch, unless otherwise indicated.
 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.3 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length
 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360° around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semi rigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

- C. Shaped Pipe Markers: Preformed semi rigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme. Provide 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch- thick brass.
 - 2. Valve-Tag Fasteners: Brass wire-link or beaded chain

PART 3 EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Fuel-burning units, including boilers, furnaces, heaters, and make up air units
 - 2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - 4. Fans, blowers, air handling units primary balancing dampers, and mixing boxes.
 - 5. Packaged HVAC central-station and zone-type units.
 - 6. Split system D/X and packaged D/X equipment
 - 7. Variable air volume (VAV) boxes – tags should be located on the underside of the ceiling.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 - 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for

greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

2. Locate markers where accessible and visible.

- C. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior unconcealed 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 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 markers.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; compressed air systems, all overhead reel systems, 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:
 1. Valve-Tag Size and Shape:
 - a. 2 inches square.
 2. Valve-Tag Color:
 - a. Black
 3. Letter Color:
 - a. White

3.5 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- B. Clean faces of mechanical identification devices

END OF SECTION 22-05-53

Commissioning of Plumbing

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
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SECTION 22 08 00 – COMMISSIONING OF PLUMBING

PART 1 GENERAL

1.1 SUMMARY

- A. The purpose of this Section is to define Contractor responsibilities in the commissioning process, which are being directed by the Contractor. Other plumbing system testing is required under other Division 22 Specification Sections.
- B. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Division 22 shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Contractor and shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- C. Plumbing systems to be commissioned include the following:
 - 1. Domestic Water Systems
 - 2. Plumbing Fixtures
 - 3. Plumbing Piping Systems

1.2 RELATED SECTION

- A. Section 01 1000 - Summary
- B. Section 01 3300 - Submittal Procedures
- C. Section 01 9113 - General Commissioning Requirements
- D. Section 22 1116 - Domestic Water Piping
- E. Section 22 1413 - Drainage and Vent Systems
- F. Section 22 4000 - Plumbing Fixtures
- G. Section 22 6313 - Gas Piping for Laboratory and Healthcare Facilities
- H. Section 22 6600 - Chemical Waste Systems

1.3 ABBREVIATIONS & DEFINITIONS

- A. Approval - acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.
- B. Architect's Supplemental Instruction (ASI)

- C. Basis of Design (BOD) – documentation of the primary thought processes and assumptions behind the design decisions that were made to meet the Owner’s Project Requirements. The Basis of Design describes the systems, components, conditions, and methods chosen to meet these requirements.
- D. Building Automation System (BAS) - computer-based control system installed in buildings that controls and monitors the building’s mechanical and electrical equipment
- E. Commissioning (Cx) - a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meet defined objectives and criteria.
- F. Commissioning Agent (CxA) - an independent agent not otherwise associated with the A/E team members or the Contractor. The CxA directs and coordinates the day-to-day commissioning activities.
- G. Commissioning Plan - an overall plan that provides the structure, schedule and coordination planning for the commissioning process.
- H. Controls Contractor (CC) – installer of the BAS, including wiring, mounting of input devices, sensors and output devices, installation of primary and secondary controllers, software and operator interfaces
- I. Deficiency - a condition in the installation or function of a component, piece of equipment, or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).
- J. Design Intent - the ideas, concepts and criteria that are considered to be very important to the Owner. It is initially the outcome of the programming and conceptual design phases.
- K. Factory Testing: Testing of equipment at the factory, by factory personnel with an Owner’s representative present if deemed necessary by Owner.
- L. Functional Performance Test (FPT) - test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Systems are tested under various modes, such as during low load conditions, component failures, unoccupied mode, power failure, etc. The commissioning agent develops the functional performance test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FPTs are performed after pre-functional checklists and startup is complete.
- M. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data-loggers or the trending capabilities of building’s energy management system.
- N. Non-Compliance (also Non-Conformance) - a condition in the installation or function of a component, piece of equipment or system that does not perform properly or is not complying with the design intent.

- O. Owner’s Project Requirements (OPR) – document outlining the owner’s expectations and goals for the performance of the building upon project completion.
- P. Phased Commissioning - Commissioning that is completed in phases due to construction scheduling issues.
- Q. Pre-Start / Start-Up Checklist - a list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the Electrical Contractor. This checklist consists primarily of static inspections and procedures to prepare the equipment or system for initial operation (e.g. belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated etc.). However, some checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system).
- R. Seasonal Performance Test - FPT that is deferred until the system will experience conditions closer to their design conditions.
- S. Simulated Condition - condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).
- T. Start-up - the initial starting or activating of dynamic equipment including executing the Pre-Start / Start-Up checklist.
- U. Test procedure - the step-by-step process which must be executed to fulfill the test requirements specifying what modes and functions, etc. shall be tested.

1.4 ROLES AND RESPONSIBILITIES

- A. The following describes the roles of the trade contractors in the commissioning process.
 - 1. General Contractor
 - a. Include the cost for commissioning requirements in the contract price.
 - b. Include commissioning requirements in the plumbing and other appropriate sub-contracts.
 - c. Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the commissioning plan.
 - d. Remedy deficiencies identified during the verification test and FPT process.
 - 2. Plumbing Contractor
 - a. Include cost for commissioning requirements in the contract price.
 - b. Include requirements for copies of documents and training in each sub-contract.
 - c. Ensure representation and cooperation of applicable trade contractors.
 - d. Ensure participation of Plumbing equipment manufacturers and/or suppliers’ representatives in appropriate testing and training activities.
 - e. Attend commissioning coordination meeting with CxA.
 - f. Prepare and provide construction schedule to CxA, including estimated equipment delivery dates, pipe system testing, equipment start-up. Update schedule as appropriate and notify CxA of these updates throughout construction process.
 - g. Gather submittals from equipment manufacturers and provide to CxA prior to installation.

- h. Conduct plumbing system orientation and inspection at the completion of plumbing equipment placement. For phased scheduling, conduct multiple orientation and inspections as appropriate.
 - i. Update drawings to record current condition (continual as-builts).
 - j. Notify CxA at least two weeks prior to system start-up and testing. Perform start-up and testing with CxA present.
 - k. Notify CxA at least two weeks prior to commencement of TAB services.
 - l. Coordinate timing of FPTs with CxA. Perform FPTs with CxA present.
 - m. Gather O&M data for all equipment and provide a copy to CxA prior to completion of construction.
 - n. Participate in training sessions.
 - o. Provide CxA with certificate of readiness stating all HVAC systems are complete and have been tested in accordance with functional performance testing procedures.
 - p. Provide a complete set of as-built records to the CxA at completion of Work.
- B. The following paragraphs present a brief description of the responsibilities of parties outside of trade divisions. These descriptions are provided to assist the trade contractors in their understanding of the overall commissioning process
- 1. Owner
 - a. Provide Owner’s Project Requirements (OPR) on which design is based.
 - b. Identify and assign a representative who has the authority to make decisions in a timely manner regarding the commissioning process.
 - c. Assign maintenance personnel to participate in the commissioning process.
 - 2. Commissioning Agent
 - a. Develops and executes the Commissioning Plan through the organization of meetings, observation of the construction, presence at tests described in the Plan and coordination of commissioning document development.
 - b. Compiling the A/E and Contractors contributions to the Systems Manual.
 - c. Reviewing all documentation submitted for accuracy and completeness for the Systems Manual.
 - d. Providing a copy of the Systems Manual to the Owner, Facilities Manager, or other applicable parties.
 - 3. Architect
 - a. Provide Design Intent and Basis of Design information that developed from the Owner’s Requirements.
 - 4. Plumbing Designer
 - a. Provide Design Intent and Basis of Design information that developed from the Owner’s Requirements.

1.5 QUALITY ASSURANCE

- A. Appropriate personnel (i.e. Project Manager and/or Field Foreman) in the employ of the Plumbing Contractor and certain Trades Contractors shall assist the CxA in coordinating and executing the required commissioning activities. These personnel shall become familiar with the Commissioning Plan and shall coordinate the tasks, documentation and submissions required by this Plan. These personnel shall review these documents for compliance with the commissioning requirements and shall arrange for remedies to deficiencies noted in these documents.
- B. The Contractor shall properly coordinate with the CxA throughout the construction of the project.

- C. The CxA will be an objective advocate of the Owner observing the commissioning activities of the Contractor and will make final recommendations to the Owner regarding functional performance of the commissioned building systems. The CxA will prepare a Commissioning Plan for coordination with the design/build team to assure an efficient design and construction process that provides verification to the Owner through a seamless commissioning process which blends their activities into the overall project schedule.
- D. All submittal data for systems and components to be commissioned shall be submitted to the CxA for use in the Cx process. The Contractor shall submit additional copies of submittals for the use in the Commissioning process.
- E. The Contractor shall schedule the work taking into account the activities to be performed by the Commissioning Agent. No claim for delay or request for an extension of Contract Time will be allowed as the result of the scheduled activities of the Commissioning Agent.

1.6 DOCUMENTATION

- A. The Plumbing Contractor shall provide copies of documents gathered or developed during the construction process to the Commissioning Agent in a timely and accurate manner. Where documents are developed by a Trades Contractor, Plumbing Contractor shall make sure that those documents are provided to the Commissioning Agent. The documents required are:
 - 1. Construction schedule, including estimated dates for equipment delivery, system testing, and equipment start-up. Provide updated schedules as appropriate.
 - 2. Procedures and status reports, including deficiencies noted.
 - 3. Minutes from all meetings concerning PLUMBING contractors and/or the commissioning process.
 - 4. All manufacturer's equipment submittals showing the manufacturer and model number, installation and start-up instructions, sequence of operation, performance data, performance test procedures and controls drawings.
 - 5. Field checkout sheets to be used by the factory or field technicians.
 - 6. As-built records.
 - 7. Posted systems diagrams.

PART 2 PRODUCTS

2.1 TOOLS AND EQUIPMENT

- A. The Plumbing Contractor shall furnish all special tools and equipment required during the commissioning process. The owner shall furnish necessary utilities for the commissioning process.
- B. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed.

PART 3 EXECUTION

3.1 GENERAL

- A. A commissioning kickoff meeting with all commissioning team members shall be held at a time and place designated by the Owner. The purpose of this meeting shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.
- B. Plumbing Contractors shall complete all phases of work so the systems can be started, tested, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.
- C. Plumbing Contractors shall assist the CxA in preparing the Commissioning Plan by providing pertinent information pertaining to the actual equipment and installation. If changes have been made to the contract schedule that alters the commissioning process, Plumbing Contractor shall notify CxA immediately.
- D. Acceptance procedures are normally intended to begin prior to completion of a system and/or sub-systems. Start of acceptance procedures before system completion does not relieve the contractor from completing those systems as per the schedule.

3.2 PARTICIPATION IN ACCEPTANCE PROCEDURES

- A. Contractors shall notify CxA when systems are ready for testing, including Pre-Start, Start-Up and Functional Performance Tests and final commissioning verification. Contractor shall provide completed commissioning data sheets to CxA as appropriate for each stage of the commissioning process.
- B. The Contractors shall provide skilled technicians to start-up and debug all systems. These same technicians shall be made available to assist the CxA in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the CxA and coordinated by the contractor. Contractor shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- C. System performance problems and discrepancies may require additional technician time, CxA time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained.
- D. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and a willingness to work with the CxA. The CxA reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system.

3.3 PRE-START / START-UP TESTS

- A. Pre-Start / Start-Up tests are operating tests and checks to verify that all components, equipment, systems, sub-systems, and interfaces between systems, operate in accordance with contract documents. These tests include all operating modes, interlocks, specified control responses, specific responses to abnormal or emergency conditions and verification of the proper response of the building automation system controllers and sensors.
- B. Calibration of all sensors shall be conducted as part of these tests.
- C. Plumbing Contractors and appropriate subs shall provide the services of a technician(s) who is (are) familiar with the construction and operation of the system(s) being tested. Provide access to the contract plans, shop drawings, and equipment cut sheets of all installed equipment. Provide details of the control system, schematics, and a narrative description of control sequences of operation.
- D. Electrical Contractor will provide a foreman electrician familiar with the electrical interlocks, interfaces with emergency power supply, and interfaces with alarm and life-safety systems. Provide access to the contract plans, and all as-built drawings of sub-systems, interfaces, and interlocks.
- E. Provide checklists for each component, piece of equipment, system, and sub-system, including all interface interlocks, etc. Manufacturer's standard written start-up and check-out procedures are acceptable. These checklists should include lines for recording the checking and outcome of each procedure and should include a summary area with signature block.
- F. All test procedures and data sheets shall be submitted to the design professional for review and acceptance.
- G. Contractor shall perform the following tests and checks. The CxA shall direct and witness the tests and check all equipment and systems.
 - 1. Set the system equipment (i.e., pumps, fans, etc.) into the operations mode to be tested, i.e. normal, shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions, in turn.
 - 2. Allow the Commissioning Agent to inspect and verify the position of each device and interlock identified on the checklist. Each item shall be signed off as acceptable (yes), or failed (no).
 - 3. This test shall be repeated for each operating cycle that applies to the plumbing system to be tested.
 - 4. Perform operating tests with Commissioning Agent present. Operating checks shall include all safety cutouts, alarms, and interlocks with smoke control and life safety systems during all modes of operation of the mechanical system.
 - 5. If during a test an operating deficiency is observed, Contractor and Commissioning Agent shall discuss, remedy and document.
- H. If the Contractor submits a Certificate of Readiness but the Commissioning Agent finds the subject system not ready for Functional Testing, or if the system fails to pass the Functional Test, the Contractor will be responsible for payment of the cost of the Commissioning Agent's time and expenses for a return site visit.

3.4 FUNCTIONAL PERFORMANCE TESTING

- A. The objective of functional performance tests is to determine if each HVAC system operates in accordance with the documented design intent and contract documents.
- B. Contractor(s) shall provide CxA with the necessary documents prior to starting Functional Performance Tests.
- C. Participants in the functional performance tests shall be the same as those listed in the verification tests.
- D. The CxA shall supervise and direct all functional performance tests.
- E. Each test shall be performed under conditions that simulate actual conditions as close as practicable. The Contractor executing the test shall provide all materials and system modifications necessary to simulate the required conditions. At completion of the test, the Contractor shall return affected equipment and systems to their pre-test condition.
- F. A preliminary functional performance test report shall be prepared by the CxA and submitted to the Architect for review. Any identified deficiencies need to be evaluated by the design professional and General Contractor to determine if they are part of the contractor's or sub-contractor's contractual obligations. Construction deficiencies shall be corrected by the responsible contractor(s), and the specific functional performance test repeated.
- G. If it is determined that that a plumbing system is constructed in accordance with the contract documents, and the performance deficiencies are not part of the contract documents, the owner must decide whether any required modifications needed to bring the performance design intent shall be implemented, or if the test shall be accepted as submitted. If corrective work is performed, the owner shall determine if a portion or all required functional performance tests should be repeated, and a revised report submitted.

3.5 DEFICIENCY RESOLUTION

- A. Deficiencies identified during commissioning process may result in additional work being required to commission the systems. The Owner and/or Architect shall have final jurisdiction over any additional work done to achieve performance.
- B. Re-testing may be required after system adjustments and/or replacements are completed. The contractor(s) and suppliers shall include a reasonable reserve to complete this work as part of their contractual obligations.

3.6 OPERATION AND MAINTENANCE (O&M) Manuals

- A. Prior to substantial completion, the Contractor shall submit O&M manuals, documentation and redline as-builts for systems that were commissioned to the CxA for review and verification of compliance with the Specifications. The Commissioning Agent will communicate deficiencies in the manuals to the Owner and Contractor. Upon a successful review of the corrections, the Commissioning Agent recommends approval and acceptance of these sections of the O&M manuals to the Owner. The Commissioning Agent also reviews each equipment warranty and

verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

- B. The O&M Manual submitted by the contractor shall include the following:
1. Name, address and telephone number of the manufacturer and installing contractor and the 24-hour number for emergency service for each piece of equipment
 2. Submittal and Product Data. This section shall include all approved submittal data, cut sheets, data base sheets and appropriate shop drawings. If submittal was not required for approval, descriptive product data shall be included.
 3. Manufacturers' brochures (including controls): Manufacturers' descriptive literature covering devices and equipment used in the system, together with illustrations, exploded views and renewal parts lists. Manufacturers' literature shall be corrected so that information applying to the actual installed equipment is clearly defined.
 4. Operation and Maintenance Instructions. These shall be the written manufacturer's data with the model and features of this installation clearly marked and edited to omit reference to products or data not applicable to this installation. This shall include data on the following:
 - a. Model number, serial number and nameplate data for each piece of equipment and any subcomponent.
 - b. Installation, startup and break-in instructions.
 - c. All starting, normal shutdown, emergency shutdown, manual operation and normal and emergency operating procedures and data, including any special limitations.
 - 1) Step-by-step procedure for system startup, including a pre-start checklist. Refer to controls and indicators by nomenclature consistent with that used on panels and in control diagrams.
 - 2) Sequence of operation, with detailed instruction in proper sequence, for each mode of operation (i.e., day-night; staging of equipment).
 - 3) Emergency operation: If some functions of the equipment can be operated while other functions are disabled, give instructions for operations under these conditions. Include here only those alternate methods of operations (from normal) which the operator can follow when there is a partial failure or malfunctioning of components, or other unusual condition.
 - 4) Shutdown procedure: Include instructions for stopping and securing the equipment after operation. If a particular sequence is required, give step-by-step instructions in that order.
 5. O&M and installation instructions that were shipped with the unit.
 6. Preventative and corrective maintenance, with service procedures and schedules:
 - a. Provide a schedule for preventive maintenance in a printed format and an electronic format compatible with owner's system. State, preferably in tabular form, the recommended frequency of performance for each preventive maintenance task, cleaning, inspection and scheduled overhauls.
 - b. Cleaning: Provide instructions and schedules for all routine cleaning and inspection with recommended lubricants.
 - c. Inspection: If periodic inspection of equipment is required for operation, cleaning or other reasons, indicate the items to be inspected and give the inspection criteria for: motors; controls; filters and any other maintenance items.
 - d. Provide instructions for minor repairs or adjustments required for preventive maintenance routines. Identify test points and give values for each. Include sensor calibration requirements and methods by sensor type.

- e. Corrective maintenance instructions shall be predicated upon a logical effect-to- cause troubleshooting philosophy and a rapid replacement procedure to minimize equipment downtime.
 - f. Troubleshooting tables, charts, or diagrams shall be used to present specified procedures. A guide to this type shall be a three-column chart. The columns shall be titled: malfunction, probable cause and recommended action.
 - g. Repair and Replacement: Indicate repair and replacement procedures most likely to be required in the maintenance of the equipment.
7. Safety Precautions: This subsection shall comprise a listing of safety precautions and instructions to be followed before, during and after making repairs, adjustments or routine maintenance.
 8. Supply any special tools required to service or maintain the equipment.
 9. Performance data, ratings and curves.
 10. Warranty and guarantee, which clearly lists conditions to be maintained to keep warranty in effect and conditions that would affect the validity of the warranty.
 11. Any service contracts issued.
 12. Supplemental Data. Prepare written text and/or special drawings to provide necessary information, where manufacturer's standard printed data is not available and information is necessary for a proper understanding and operation and maintenance of equipment or systems, or where it is necessary to provide additional information to supplement data included in the manual or project documents.

3.7 SYSTEMS MANUAL

- A. A Systems Manual shall be provided to the owner, in addition to the O&M manuals, under LEED requirements for EAc2 Enhanced Commissioning. The focus shall be on operating, rather than maintaining the equipment, including the interactions between equipment.
- B. The Contractor shall be responsible for providing:
 1. As-built sequences of operations, control drawings, and a full print out of original set points and schedules for each piece of commissioned equipment. Copies of all checkout tests and calibrations performed by the contractor (not commissioning tests) shall also be included.
 2. Operating instructions for integrated building systems
 3. Recommended schedule of maintenance requirements and frequency
 4. Recommended schedule for retesting of the commissioned systems

3.8 TRAINING OF OWNER PERSONNEL

- A. The Contractor shall be responsible for training coordination and scheduling, and ultimately for ensuring that training is complete.
- B. The CxA shall be responsible for overseeing and approving content and adequacy of the training of Owner Personnel for commissioned equipment.
- C. A training plan shall be submitted to the CxA for review before such training is set to occur. It should include the following:
 1. Equipment or systems
 2. Intended audience
 3. Location of training

4. Objectives
 5. Subjects covered (description, duration of training)
 6. Instructor and qualifications for each subject
 7. Methods (classroom lecture, manufacturer's quality video, site walk-through, actual operational demonstrations, written handouts, etc.)
- D. Training shall normally start with classroom sessions followed by hands-on demonstration/training on each piece of equipment. Training shall include:
1. Use of the printed materials included in the O&M manuals or System manuals.
 2. 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 startup, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
 3. Discussion of relevant health and safety issues and concerns.
 4. Discussion of warranties and guarantees.
 5. Common troubleshooting problems and solutions.
 6. Discussion of any peculiarities of equipment installation or operation.
- E. 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 shall be repaired or adjusted as necessary and the demonstration repeated at another scheduled time, if necessary.
- F. Provide designated owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment that makes up the system.
- G. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. More than one party may be required to execute the training.
- H. The contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls not controlled by the central control system.
- I. At the discretion of the CxA, training may occur before performance testing is complete if required by the facility operators to assist the CxA in the performance testing.

END OF SECTION 22-08-00

Domestic Water Piping

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

SECTION 22 11 16 – Domestic Water Piping

PART 1 GENERAL

1.1 GENERAL

- A. All pipe, fittings, and pipe joining material used for potable water systems shall be lead free in accordance with state and federal regulations.

1.2 RELATED DOCUMENTS

- A. Requirements of Section 01 including, but not limited to, General Requirements, Submittal Procedures, Quality Requirements, Product Requirements, Substitution Procedures, Operation and Maintenance Data, Demonstration and Training shall apply to all work under this section.

1.3 SUMMARY

- A. This Section specifies the water distribution piping system, including potable cold, hot, water piping, fittings, and specialties within the building.
- B. Products installed but not furnished under this Section include water meters which will be provided by the Utility Company, to the site, ready for installation.

1.4 RELATED SECTIONS

- A. The following Sections contain requirements that relate to this Section.
 - 1. Refer to Civil specification for "Site Water Service Piping" for water service piping.
 - 2. Section 31 - "Earthwork" for trenching and backfilling materials and methods for underground piping installations.
 - 3. Section 07 - "Joint Sealers" for materials and methods for sealing pipe penetrations through basement walls and fire and smoke barriers.
 - 4. Section 22 - "Gauges" for thermometers, flow meters, and pressure gauges.
 - 5. Section 22 - "Mechanical Identification" for labeling and identification of piping system.

1.5 DEFINITIONS

- A. Water Distribution Piping: A pipe within the building, or on the premises, which conveys water from the water service pipe, or meter, to the points of usage.
- B. Water Service Piping: The pipe from the water main, or other source of potable water supply, to the water distributing system of the building served.
- C. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

1.6 SUBMITTALS

- A. Submit shop drawings, minimum of 1/4" scale, drawings shall be done in AutoCAD 2009 or later release. Shop drawings shall include pipe routing with elevations, dimensions, floor penetration

locations. All systems shall be coordinated with structural, architectural and all other trades. Shop drawing includes piping for underground and above ground for all plumbing systems.

- B. Product data, including operation and maintenance data, for each piping specialty and valve specified.
- C. Welder's certificates certifying that welders comply with requirements specified in Quality Assurance below.
- D. Certification of Compliance with ASME and UL fabrication requirements specified below.
- E. Test reports specified in Part 3 of this specification.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the provisions of the following:
 - 1. ASME B 31.9 "Building Services Piping" for, materials, products and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
 - 2. ASME "Boiler and Pressure Vessel Code," Section IX. "Welding and Brazing Qualification" for Qualifications for Welding Processes and Operators.
 - 3. New Orleans Sewage and Water Board Plumbing Code.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with NSF/ANSI Standard 61 requirements for potable domestic water piping and components.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store pipe and fittings in a manner to prevent sagging and bending and as per manufacturer.
- B. Recommendation to be protected from direct sunlight.

1.9 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad. Refer to Section 03 for concrete and formwork requirements.
- B. Coordinate the installation of pipe sleeves for foundation wall penetrations.

1.10 EXTRA STOCK

- A. Maintenance Stock: Furnish one valve key for each key operated hydrant, bibb, or faucet installed.

PART 2 PRODUCTS

2.1 GENERAL

- A. Furnish materials in accordance with city of [Insert town/city of project] standards.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Submit seven reproducible copies for review
 2. Basket Strainers:
 - a. Josam Mfg. Co.
 - b. Metraflex Co.
 - c. Mueller
 - d. Spirax Sarco
 - e. Smith (Jay R.) Mfg. Co.
 3. Balance Cocks:
 - a. American Air Filter Co.
 - b. Bell & Gossett ITT; Fluid Handling Div.
 - c. Hammond Valve Corp.
 - d. Milwaukee Valve Co., Inc.
 - e. Spirax Sarco
 - f. Taco, Inc.
 4. Bibbs and Faucets:
 - a. Chicago Faucet Co.
 - b. Hammond Valve Corp.
 - c. Mansfield Plumbing Products
 - d. Nibco Inc.
 - e. Watts Regulator Co.
 5. Hydrants:
 - a. Josam Mfg. Co.
 - b. Jay R. Smith Mfg. Co.
 - c. Wade/Tyler Pipe; Sub. of Tyler Corp.
 - d. Watts Drainage Products
 - e. Woodford Mfg. Co.
 - f. Zurn Industries Inc., Hydromechanics Div.
 6. Backflow Preventers:
 - a. Febco Sales, Inc.: Subs. of Charles M. Bailey Co., Inc.
 - b. Hersey Products, Inc.
 - c. Watts Regulator Co.
 - d. Zum Industries, Inc.; Wilkins-Regulator Div.
 - e. Vacuum Breakers
 - f. Watts Regulator Co.
 - g. Febco Sales, Inc.; Subs. of Charles M. Bailey Co., Inc.
 - h. Zurn Industries, Inc.; Willinr-Regulator Div.
 7. Pressure Regulating Valves:
 - a. Cash (A. W.) Valve Mfg. Corp.
 - b. Cla-Val Co.

- c. Spence Engineering Co., Inc.
- d. Watts Regulator Co.
- e. Automatic Flow Control Valves
- f. Griswold Controls
- 8. Water Meters:
 - a. Badger Meter, Inc.
 - b. Hersey Products Inc.
 - c. Neptune Water Meter Co.: Subs. Neptune Int'l.
 - d. Rockwell Int'l. Municipal & Utility Div.
 - e. Zurn Industries Inc.; Hays Fluid Controls Div.
- 9. Relief Valves:
 - a. Cash (A. W.) Valve Mfg. Corp.
 - b. Conbraco Industries, Inc.
 - c. Watts Regulator Co.
 - d. Zurn Industries, Inc.; Wilkins-Regulator Div.
- 10. Water Hammer Arresters:
 - a. Amtrol, Inc.
 - b. Josam Manufacturing Co.
 - c. Jay R. Smith Mfg. Co.
 - d. Wade/Tyler Pipe; Sub. of Tyler Corp.
 - e. Watts Drainage Products
 - f. Zurn Industries, Inc.; Hydromechanics Div.
 - g. Sioux Chief Manufacturing Co., Inc.
 - h. Precision Plumbing Products, Inc)
- 11. Dielectric Unions:
 - a. Perfection Corp.
 - b. Watts Regulator Co.
- 12. Y-Pattern Strainers:
 - a. Armstrong Machine Works
 - b. Hofhman Specialty ITT: Fluid Handling Div.
 - c. Metraflex Co.
 - d. Mueller
 - e. Spirax Sarco
 - f. Watts Regulator Co.
- 13. Press Fittings:
 - a. ProPress by Ridgid/Viega

2.3 PIPE AND TUBE MATERIALS

- A. General: Refer to Part 3, Article Applications, for identification of systems where the below materials are used.
- B. Drawn tempered copper tubing: ASTM B88, Type L
- C. Annealed tempered copper tubing: ASTM B88, Type K
- D. Ductile iron pipe: ANSI A21.51 ductile iron pipe, with ANSI A21.4 cement mortar lining.

2.4 FITTINGS

- A. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.
- B. Ductile-iron Gasketed Fittings: AWWA C110, Schedule 150, with cement mortar lining and AWWA C111 rubber gaskets.
- C. Press fittings: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or B16.22. O-rings for the copper press fittings shall be EPDM.
- D. Grooved Mechanical Couplings: Consist of non-galvanized ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings. Nuts and bolts shall be stainless steel.
- E. Cast-iron Threaded Flanges: ANSI B16.1, Class 125; raised ground face, bolt holes spot faced. Nuts and bolts shall be stainless steel.
- F. Cast Bronze Flanges: ANSI B16.24, Class 150; raised ground face, bolt holes spot faced. Nuts and bolts shall be stainless steel.

2.5 UNIONS and CONNECTORS

- A. Sweat type, wrought copper, ASTM B75, with dimensions conforming to ANSI B16.22 and sweep patterns for copper tubing.
- B. Dielectric connections: Merit Brass Company or "V-line" (as manufactured by Lochinvar Company) dielectric couplings. Use couplings at junction of steel pipe and equipment with copper piping systems. Do not use steel or cast iron fittings in copper piping system. Brass fittings shall be used for dielectric locations. Dielectric flange kits at dissimilar metal flange connections.
- C. Nipples: Unless otherwise noted, provide red-brass nipples to all pipe instruments including, but not limited to, instrument and temperature gauge thermo-wells, pressure gauges, etc. Nipples shall be designed and manufactured in accordance with Federal Specification WNN-351a, ASTM B687-88 and MS 51846.
- D. Unions: ANSI B16.39, malleable iron, Class 150, hexagonal stock, with ball- and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends. Threads shall conform to ANSI B1.20.1.
- E. Flexible Connectors: Stainless steel bellows with woven flexible bronze wire reinforcing protective jacket; minimum 150 psig working pressure, maximum 250° F operating temperature. Connectors shall have flanged or threaded end connections to match equipment connected; and shall be capable of 3/4 inch misalignment.

2.6 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, 95-5 Tin-Antimony.

1. J.W. Harris "Stay-safe 50" or equal 94.5% Tin - 0.5% Silver 3% Antimony - 1.5% Zinc 0.5% Copper.

B. Brazing Filler Metals: AWS A5.8, BCup-4 6% silver for joints below ground.

C. Copper Pipe: 2 1/2" and larger; (TIG) Gas Tungsten arc welding.

D. Gasket Material: Thickness, material, and type suitable for fluid to be handled, and design temperatures and pressures.

2.7 GENERAL DUTY VALVES

A. Valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 23 Section "Valves." Special duty valves are specified below by their generic name; refer to Part 3 Article "VALVE APPLICATION" for specific uses and applications for each valve specified. All domestic water valves shall be compliant with NSF/ANSI Standard 61.

2.8 SPECIAL DUTY VALVES (not used)

2.9 AUTOMATIC WATER FLOW CONTROL VALVES

A. General: Provide factory calibrated, direct acting, automatic pressure compensating type flow control valves. Each valve shall limit flow rates to within +5 accuracy, regardless of system pressure fluctuations.

B. Valve control mechanism shall consist of a tamperproof, stainless steel cartridge assembly with open chambers and unobstructed flow passages. Cartridge assembly shall include a self-cleaning, spring loaded moving cup guided at two separate points and shall utilize the full available differential pressure to actuate without hysteresis or binding.

C. Each valve shall be equipped with an upstream and downstream P/T fitting. Four differential pressure ranges shall be available with the minimum range requiring less than 2 psig.

D. Each valve to be provided with a metal tag, chain and stamped for system identification. Pressure taps and quick disconnect valves shall be provided with ferrous bodies.

E. All system flow control valves shall be of one manufacturer.

F. At the Contractor's option, flow control valves 1" and smaller with flow rates of 10 gpm and under, may be equipped with a combination upstream ball valve, Y-strainer with 20 mesh screen, an upstream P/T fitting, the flow control cartridge, a downstream P/T fitting, and an outlet union. Valve shall be like Griswold Ultra Z.

G. Flow control valves shall be warranted by the manufacturer for five (5) years from the date of substantial completion.

2.10 THERMOSTATIC MIXING VALVE

A. Refer to drawing schedule.

2.11 PIPING SPECIALTIES

- A. Water Hammer Arresters: Water hammer arresters shall be sized, tested and certified in accordance with PDI Standard WH-201, A.S.S.E.-1010 and A.N.S.I.-A112.26.1.
- B. Spun closed, one-piece, seamless type 'L' copper tube and factory charged, with acetal piston, three EPDM O-rings, pressure-lubricated with Dow Coming III silicone compound, FDA approved. Unit shall be pressure rated for 250 psi, designed to keep waterline at 150 psi working pressure during pressure surges following quick valve closure. Working temperature from 33° F to 250° F

OR

- C. Constructed of all stainless steel and with internal heavy-duty balanced expansion bellows, pre-charged suitable for operation in temperature range of minus 100 to 300 degrees F and maximum 250 psig working pressure.

2.12 REACTION ANCHORS

- A. Provide concrete thrust blocking or joint harness for all pressure piping in accordance with NFPA 24.
- B. Thrust blocking: Sufficient mass of concrete, bearing on solid undisturbed earth, to resist hydraulic thrust at maximum pressure to which pipe will be subjected, 150 psi minimum.
- C. Joint harness: Steel straps and rods across joints, securely anchored on pipe or other adequate anchorage to resist hydraulic thrust at maximum pressure to which pipe will be subjected, 150 psi minimum.
 - 1. Coal tar coating: Koppers Bitumastic type 50.
 - 2. Clamps, straps, and washers: steel, ASTM A506.
 - 3. Rods: Steel, ASTM A575
 - 4. Rod coupling: Malleable iron
 - 5. Bolts: Steel, ASTM A307
 - 6. Cast iron washers: Gray iron ASTM A126

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, the original design and the referenced standards.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPE APPLICATIONS

- A. Install Type L, drawn copper tubing with wrought copper fittings and solder joints for 4 inch and smaller above ground, within building. At the contractor's option, install Type L, drawn copper tubing with wrought copper press fittings in accordance with the manufacturer's recommendations for 2 inch and smaller above ground within building.
- B. Install Type K, annealed temper copper tubing for 2 inch and smaller with no joints, below ground.
- C. Install cement-lined ductile-iron pipe with rubber gasket joints below ground, inside and outside the building.

3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.
- C. Branch connections shall be made from the side or bottom of the main to facilitate drainage.
- D. Install exposed piping, at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- E. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- F. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- G. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building.
- H. Provide space to permit insulation applications, with 1-inch clearance outside the insulation.
- I. Allow sufficient space above removable ceiling panels to allow for panel removal.
- J. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- K. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.
- L. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inch and larger shall be sheet metal.

M. Fire Barrier Penetrations: Where pipes pass through time rated fire restive construction including fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Division-7 for special sealers and materials.

N. Install piping level with no pitch.

3.4 HANGERS AND SUPPORTS

A. Refer to Section 22 0529

3.5 PIPE AND TUBE JOINT CONSTRUCTION

A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."

1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering.
2. Heat joints to proper and uniform temperature.

B. Threaded Joints: Conform to ANSI B1.20. 1, tapered pipe threads for field cut threads. Join pipe fittings and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Align threads at point of assembly.
3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

C. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

D. Flanged Joints: Align flanged surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible.

1. Use suitable lubricants on bolt threads.
2. Tighten bolts gradually and uniformly using torque wrench.

E. PVC Pipe fittings: No PVC pipe allowed.

3.6 SERVICE ENTRANCE

A. Extend water distribution piping to connect to water service piping of size and in location indicated for service entrance to building. Refer to Section 22 – Facility Water Distribution Piping for additional site construction requirements.

B. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation.

C. Install shutoff valve at service entrance inside building; complete with strainer, pressure gage, and test tee with valve.

- D. Ductile-iron Pipe: Install in accordance with AWWA C-60.
- E. Reaction anchors: Use concrete thrust blocking where solid undisturbed earth is available. Use joint harnesses in other places. If lack of undisturbed earth is the result of improper trench excavation, provide joint harness at no additional cost. Coat underground metal surfaces not encased in concrete with two coats of Koppers Bitumastic Type 50. Bitumastic shall be applied to clean dry surfaces only. Allow first coat to dry before applying second coat.

3.7 VALVE APPLICATIONS

- A. General Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:
 - 1. Shut-off duty: Use gate, ball, and butterfly valves.
 - 2. Throttling duty: Use ball and butterfly valves.

3.8 INSTALLATION OF VALVES

- A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inch and smaller, use gate or ball valves; for sectional valves 2-1/2 inch and larger, use gate or butterfly valves.
- B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated. For shutoff valves 2 inch and smaller, use gate or ball valves; for shutoff valves 2-1/2 inch and larger, use gate or butterfly valves.
- C. Drain Valves: Install drain valves on each plumbing equipment item, located to completely drain equipment for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to completely drain distribution piping system. For drain valves 2 inch and smaller, use gate or ball valves; for drain valves 2-1/2 inch and larger, use gate or butterfly valves.
- D. Check Valves: Install swing check valves on discharge side of each pump, and elsewhere as indicated.
- E. Balance Cocks: Install in each hot water recirculation loop, the discharge side of each pump, and elsewhere as indicated.

3.9 INSTALLATION OF PIPING SPECIALTIES

- A. Install backflow preventers (RPZ) at make-up water connection to mechanical equipment and systems, and in compliance with the Louisiana State Plumbing Code (LSPC) and the Authority Having Jurisdiction (AHJ). Refer to contract drawings for general location of RPZ's. The AHJ shall approve the type of backflow prevention assembly or method required for containment based on the requirement of Table D104 and degree of hazard. If a cross-connection is not listed in Table D104, the Water Purveyor shall use Table B1 of the "Manual for the Selection, Installation, Maintenance, and Field Testing of Backflow Prevention Devices" (CAN/CSA Standard B64.10-1994) as a guide to determine the type of device to require. (This document is referred to in Table 606 of the LSPC, 2000 Edition.)

- B. Install pressure regulating valves with inlet and outlet shutoff valves, and balance cock bypass. Install pressure gage on valve outlet.
- C. Size and Locate Water Hammer Arresters in accordance with the following schedule, and located within an effective range of the quick-closing valve as per the requirements of Standard PDI-WH2O1 current edition, whether shown or not shown on the drawings.

| WATER HAMMER ARRESTER SCHEDULE | | | | | |
|--------------------------------|--------|-------------|----------------|----------|----------|
| MARK | I.P.S. | F.U. RATING | J.R. SMITH NO. | WADE NO. | ZURN NO. |
| 'A' | ½" | 1-11 | SC500 | W-5 | 100 |
| 'B' | ¾" | 12-32 | SC750 | W-10 | 200 |
| 'C' | 1" | 33-60 | SC1000 | W-20 | 300 |
| 'D' | 1 ¼" | 61-113 | SC1250 | W-50 | 400 |
| 'E' | 1 ½" | 114-154 | SC1500 | W-75 | 500 |
| 'F' | 2" | 155-330 | SC2000 | W-10 | 600 |

All water hammer arresters shall be P.D.I. certified.

3.10 EQUIPMENT CONNECTIONS

- A. Supplies and Trim: All supplies, hardware, trim, traps, etc. to fixtures and equipment shall be chrome plated brass if exposed.
- B. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by Plumbing Code.
- C. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection. Provide drain valve on drain connection. For connections 2-1/2" and larger, use flanges instead of unions.

3.11 FIELD QUALITY CONTROL

- A. Inspections: Inspect water distribution piping as follows:
 1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction and by the engineers.
 2. During the process of the installation, notify engineers and the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made.
 3. Perform tests specified below in the presence of the plumbing official.
- B. Rough-in Inspection: Arrange for inspection of the piping system before being concealed or closed-in after system is roughed-in, and prior to setting fixtures.
- C. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
- D. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.

- E. Reports: Prepare inspection reports, signed by the plumbing official and submit a copy to the engineer.
- F. Test water distribution piping as follows:
 - 1. Test for leaks and defects all new water distribution piping systems and parts of existing systems which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
 - 2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
 - 3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for a period of 4 hours. Leaks and loss in test pressure constitute defects which must be repaired.
 - 4. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
 - 5. Prepare reports for all tests and required corrective action.

3.12 ADJUSTING AND CLEANING

- A. Clean and Disinfect water distribution piping as follows:
 - 1. Purge all new water distribution piping systems and parts of existing systems, which have been altered, extended, or repaired prior to use.
 - 2. Hot water piping shall be sterilized with cold water, not heated.
 - 3. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction, or in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA D105 or as described below:
 - a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
 - b. Fill the system or part thereof, with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system, or part thereof, and allow to stand for 24 hours.
 - c. Drain the system, or part thereof, of the previous solution, and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
 - d. Following the allowed standing time, flush the system with clean potable water until chlorine does not remain in the water coming for the system.
 - e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
- B. Prepare reports for all purging and disinfecting activities.
- C. The Contractor shall be solely responsible for the final delivery of the potable water system approved by the Louisiana State Department of Health & Hospitals.

3.13 COMMISSIONING

- A. Fill the system.
- B. Check compression tanks to determine that they are not air bound and that the system is completely full of water.
- C. Before operating the system perform these steps:
 - 1. Open valves to fully open position. Close drain, valves, hydrants, and sill cocks.
 - 2. Remove and clean strainers.
 - 3. Check pump for proper direction of rotation. Make any necessary corrections.
 - 4. Lubricate pump motors and bearings.

END OF SECTION 22-11-16

Sanitary Waste and Vent Piping

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

SECTION 22 13 13 – SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Requirements of Section 01 including, but not limited to, General Requirements, Submittal Procedures, Quality Requirements, Product Requirements, Substitution Procedures, Operation and Maintenance Data, Demonstration and Training shall apply to all work under this section.

1.2 RELATED SECTIONS

- A. The following Sections contain requirements that relate to this Section.
 - 1. Section 02 for trenching and backfilling materials and methods for underground piping installations.
 - 2. Section 07 for materials and methods for sealing pipe penetrations through basement walls and fire and smoke barriers.
 - 3. Section 22 0553 for labeling and identification of piping system.

1.3 SUBMITTALS

- A. Product data for the following products:
 - 1. Drainage piping specialties
 - 2. Drainage pipe and fittings
 - 3. Floor drains
- B. Operation and Maintenance data for each piping specialty specified as required in Section 01.
- C. Inspection reports specified in Part 3 of this Section.
- D. Test reports specified in Part 3 of this Section.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the provisions of the following:
 - 1. Louisiana State Plumbing Code and/or adopted Codes.
 - 2. Requirements of the Plumbing Official or the Authority Having Jurisdiction.
 - 3. Piping materials shall bear label, stamp, markings of specified manufacturer or testing agency.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of drain flashing and roof penetrations.
- B. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing, and slope of slab to drains.

- C. Coordinate with installation of sanitary sewer systems as necessary to interface building drains with drainage piping systems.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide drainage and vent systems components from one of the following:
 - 1. Drainage Piping Specialties, including backwater valves, expansion joints, and vandal-proof vent caps:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Mfg. Co.
 - c. Wade/Tyler Pipe; Subs. of Tyler Corp.
 - d. Watts Drainage Products
 - e. Zurn Industries Inc.; Hydromechanics Div.
 - 2. Floor drains:
 - a. Jay R. Smith Co.
 - b. Josam Mfg. Co.
 - c. Wade/Tyler Pipe; Subs. of Tyler Corp.
 - d. Watts Drainage Products
 - e. Zurn Industries, Inc.

2.2 BELOW GROUND SANITARY AND VENT PIPE AND FITTINGS (INCLUDING GREASY WASTE)

- A. Extra Heavy (XH) Hub and Spigot Cast Iron Soil Pipe and Fittings: Extra Heavy Cast Iron pipe and fittings shall be manufactured from gray cast iron with a tensile strength of not less than 21,000 psi. Compression gaskets shall be manufactured from an elastomer meeting the requirements of ASTM C 564. Pipe and fittings shall comply with ASTM A74. Compression gaskets shall comply with ASTM C 564. All pipe and fittings shall be made in the United States, and marked with the collective trademark of the Cast Iron Soil Pipe Institute, and listed by NSF® International. All pipe and fittings shall be of the same manufacturer.

2.3 ABOVE GROUND SANITARY AND VENT PIPING AND FITTINGS

- A. Hubless Cast-Iron Soil Pipe: All waste lines and fittings shall conform to the requirements of CISPI Standard 301, ASTM C-564 or ASTM A-74. All pipe and fittings shall be made in the United States, and marked with the collective trademark of the Cast Iron Soil Pipe Institute, and listed by NSF® International. All pipe and fittings shall be of the same manufacturer.
 - 1. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions and local codes requirements. Hubless couplings shall conform to CISPI 310 or ASTM C1277, C564 or ASTM G1540 for super duty couplings.
- B. PVC pipe shall not be used.

2.4 DRAINAGE PIPING SPECIALTIES

- A. Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1, countersunk head.
- B. Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide underdeck clamp and sleeve length as required.
- C. Cleanouts:
 - 1. Floor Cleanouts: Cast-iron body and frames or combination cast-iron/ABS body and frame; brass cleanout plug; nickel-bronze adjustable round top. Manufacturer's standard cast unit of pattern indicated as follows:
 - a. Pattern: Exposed flush type, standard non-slip scoriated finish; Jay R. Smith 4023. Nickel Bronze Round top.
 - b. Pattern: In carpeted areas, Polished Bronze flush type, standard non-slip scoriated finish, stainless steel carpet marker; Jay R. Smith 4023Y.
 - c. Pattern: In tile, Nickel Bronze, flush type, standard non-slip scoriated finish: Jay R. Smith 4143, round top.
 - d. Pattern: In terrazzo, Nickel Bronze, flush type, standard non-slip scoriated finish: Jay R. Smith 4183, round top.
 - 2. Wall Cleanouts: Duco cast iron caulk ferrule with cast bronze taper threaded plug nickel bronze frame and polished bronze secured cover flush with wall like Jay R. Smith model 4435.
- D. Floor drains:
 - 1. General: Provide floor drains of size as indicated on drawings; and type, including features, as specified in Drawing P100 schedule.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.
- B. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into account many design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.

- C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inches shall be steel; pipe sleeves 6 inches and larger shall be sheet metal.
- H. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Section 07 for special sealers and materials. All piping penetrations through fire rated walls shall be cast iron.
- I. Make changes in direction for drainage and vent piping using appropriate 45-degree wyes, half-wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn tees where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

3.3 HANGERS AND SUPPORTS (ABOVE GROUND and BELOW GROUND)

- A. General: Hanger, supports, and anchors devices are specified in Section 22 0529 – Pipe Hangers. Conform to the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
 - 2. Install hangers at the intervals required by local Plumbing Code.
 - 3. For below ground, pipe shall be installed with stainless steel hangers and rods at 4'-0' foot spacing with a hanger at every joint. Pipe supports shall meet the requirements of the local Plumbing Code.

3.4 INSTALLATION OF PIPING SPECIALTIES

- A. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.
 - 1. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:
 - a. As required by plumbing code;
 - b. At each change in direction of piping greater than 45 degrees;

- c. At minimum intervals of 50 ft. for piping 4" and smaller and 75 ft. for larger piping;
 - d. At base of each vertical soil or waste stack.
2. Cleanouts Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.
- B. Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.

3.5 INSTALLATION OF FLOOR DRAINS

- A. General: Install floor drains in accordance with manufacturer's written instructions and in locations indicated.
- B. Coordinate flashing work with work of waterproofing and adjoining substrate work.
- C. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.
- D. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring.
- E. Maintain integrity of waterproof membranes, where penetrated.
- F. Position drains so that they are accessible and easy to maintain.
- G. Waterproof each floor drain above ground by providing a 16-inch x 16-inch flashing constructed in place using 40 mil chlorinated polyethylene sheets (Chloraloy 240). Install using manufacturers recommended procedure and in accordance with the Plumbing Code. Installation of flashing shall be coordinated with the floor construction.

3.6 CONNECTIONS

- A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.
- B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.7 FIELD QUALITY CONTROL

- A. Inspections:
 - 1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction and the engineer.
 - 2. During the progress of the installation, notify the plumbing official having jurisdiction and the engineer at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
 - a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.

- b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
 3. Re-inspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for re-inspection by the plumbing official.
 4. Reports: Prepare inspection reports, signed by the plumbing official.
- B. Piping System Test drainage and vent system as follows:
 1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
 2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
 3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
 4. Finished Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Plug the stack openings on the roof and building drain where it leaves the building, and introduce air into the system equal to a pressure of 1" water column. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without the introduction of additional air throughout the period of inspection. Inspect all plumbing fixture connections for gas and water leaks.
 5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
 6. Prepare reports for all tests and required corrective action.

3.8 ADJUSTING AND CLEANING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.9 PROTECTION

- A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
- C. Exposed ABS or PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water-based latex paint.

END OF SECTION 22-13-13

Sump Pump

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

SECTION 22 13 29– SUMP PUMP

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submersible Sump Pumps
 - 2. Column Sump Pumps
 - 3. Pump Controls and Accessories
- B. Related Sections:
 - 1. Section 220503 - Pipes and Tubes for Plumbing Piping and Equipment.
 - 2. Section 220523 - General-Duty Valves for Plumbing Piping.
 - 3. Section 333100 - Sanitary Utility Sewerage Piping.

1.2 DEFINITIONS

- A. Alternator: A device that changes the starting order of pumps in a multiple-pump system.
- B. Lag Pump: The second pump to be energized in a multiple-pump system.
- C. Lead Pump: The first pump to be energized in a multiple-pump system.

1.3 REFERENCES

- A. List reference standards included within text of this section. Edit the following for Project conditions.
 - 1. National Electrical Manufacturers Association:
 - a. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. Underwriters Laboratories Inc.:
 - a. UL 778 - Motor Operated Water Pumps.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings:
 - 1. Submit installation details for pumps, piping, controls and accessories including wiring schematics.
- C. Product Data:
 - 1. Submit pump type and capacity.
 - 2. Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.

3. Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
 4. Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.
 5. Submit cutsheets and schematics for pump controls.
 6. <<<<<FOR DUPLEX SYSTEMS>>>>> Duplex sump pump panels to be provided for each sump pit, included with any gateway cards as required by controls contractor.
- D. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Manufacturer Reports: Certify that pumps have been installed according to manufacturer's instructions.
- H. Qualifications Statement:
1. Submit qualifications for manufacturer

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.
- B. Installer: Company specializing in performing Work of this section with minimum three years' experience.
- C. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.6 QUALITY ASSURANCE

- A. Conform to IPC and UL standards.
- B. Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1.
- C. Perform Work in accordance with the city of [Insert town/city of project] work standards.
- D. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

- B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. This article extends warranty period beyond one year. Extended warranties increase construction costs and Owner enforcement responsibilities. Specify warranties with caution.
- B. Furnish five-year manufacturer warranty for pumps.

PART 2 PRODUCTS

2.1 GENERAL

- A. Furnish materials in accordance with city of [Insert town/city of project] standards.
- B. Product information in this specification is general requirements for pumps. Suppliers shall refer to the specific requirements for each pump that is found on the data sheets.
- C. The term “wetted parts” shall include the pump shaft.

2.2 SUBMERSIBLE SUMP PUMP

- A. Type: Submersible
- B. Preferred Manufacturer: Sump pumps shall be Barnes, Goulds, or Bell & Gossett, duplex pumping unit with vertical shaft driven single stage pumps.
- C. Description: Completely submersible, vertical, centrifugal.
- D. Performance and Design Criteria: Refer to drawing schedule
- E. Casing:
 - 1. Pump Body: Cast iron.
 - 2. Motor Chamber: Oil filled.

- F. Impeller:
 - 1. Type: Open, non-clog.
 - 2. Material: Bronze.
- G. Shaft Material: Stainless steel.
- H. Bearings: Ball type.
- I. Mounting: Slide-away coupling consisting of discharge elbow secured to sump floor, movable bracket, guide pipe system, lifting chain, and chain hooks.
- J. Operation:
 - 1. Electrical Characteristics: Refer to drawing schedule
 - 2. Controls:
 - a. Type: Integral diaphragm.
 - b. Furnish separate level switch-activated HIGH LEVEL alarm with transformer, alarm bell, and standpipe.
 - 3. Disconnect Switch: Factory mounted in control panel.
- K. Accessories
 - 1. Cord and Plug:
 - a. Oil resistant.
 - b. Length: 10 feet.
 - c. Furnish three-prong connector for connection to electric wiring system.
 - d. Furnish grounding connector

2.3 COLUMN SUMP PUMP

- A. Type: Column
- B. Capacity:
 - 1. As indicated on drawings.
 - 2. Sump pumps shall be Barnes, Goulds, or Bell & Gossett, duplex pumping unit with vertical shaft driven single stage pumps
- C. Construction:
 - 1. For sanitary sump pumps the inlet shall be open to the impeller and it shall be capable of handling typical sewage without clogging.
 - 2. For storm the inlet shall be complete with a screen over the impeller.
 - 3. Shaft shall be rust-resistant alloy steel. Pump design shall permit easy adjustment of the impeller in the volute. Bearings shall be grease lubricated with grease fittings anchored on cover plates.
 - 4. Provide intermediate bearings complete with lubrication lines for all pumps in pits over 5 ft. deep. Provide intermediate couplings to facilitate pump removal in limited headroom conditions.
 - 5. Pumps shall be mounted on a prime painted steel cover plate that shall be sufficiently strong and rigid to support the pump or pumps, pump accessories and serviceman without vibration or deflection. An inspection cover shall be provided in the cover plate

D. Controls:

1. There shall be two float operated switching mechanisms with pedestal-mounted switch, copper float and guided rod with adjustable stops. A switch compensating spring shall be provided, as required, for deep sumps.
2. The switching mechanism connected to one of the floats shall be a mechanical alternator. Action of the alternator shall be to alternate the lead pump in sequential starts. The switching mechanism connected to the other float shall start both pumps should the water level rise above the operating level of the alternator float.
3. There shall be a high water alarm switch complete with transformer and bell, and auxiliary contacts for wiring to the building CEMS system.
4. All controls shall be mounted in a EEMAC 3R (sprinkler proof) control panel and shall be complete with all starters, power wiring, control wiring, hand-off-auto switch and pilot light for each pump, transformer and wiring to the alarm panel and shall require only a single power supply by the Electrical Division. All conduit shall enter from the bottom only.

E. Sump Covering

1. A prime painted steel frame shall be provided for receiving the cover plate in a concrete sump. Frame shall include a gasketed recess dimensioned for the cover plate, stainless steel threaded studs and nuts for fastening the cover and concrete anchors welded on at approximately 18 in. centers.
2. The size of the cover plate and frame shall be determined from the pit size shown on the Drawings.
3. All openings in cover plate and frame shall be gasketed for sanitary sump pumps.
4. Provide frames and cover plates for sand traps and inspection pits.
5. Provide galvanized steel ladder rungs at 12 in. on centers for full depth of all pits.

F. Testing:

1. Obtain flow tests to determine actual flow rates before ordering pumps.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide line-sized ball valve, line-sized soft seated check valve and balancing valve on pump discharge.
- B. Check valves downstream of pumps shall be swing type with external lever and adjustable weight
- C. Furnish following spare parts: packing, seals, filters.
- D. If the main control panel is shipped without a splitter to serve the alarm panel, supply and install an additional junction box before the control panel to serve all related panels.
- E. Decrease from line size with long-radius reducing elbows or reducers.
- F. Support piping adjacent to pump independently of pump casings.

3.2 FIELD QUALITY CONTROL

- A. Check, align, and certify alignment of pumps prior to startup.
- B. Startup and Performance Testing:
 - 1. Operate pump using clear water for continuous period of 10 minutes in presence of Architect/Engineer.
 - 2. Verify pump performance by performing time-drawdown test or time-fill test.
 - 3. Check pump and motor for high temperature and excessive vibration.
 - 4. Check for motor overload by taking ampere readings.
- C. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

3.3 DEMONSTRATION

- A. Demonstrate pump startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 22-13-29

Electric Domestic Water Heaters

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
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SECTION 22 33 00 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Residential electric water heaters.
 - 2. Commercial electric water heaters.
 - 3. Tankless water heaters

- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for concrete housekeeping pads specified by this section.
 - 2. Section: 22 11 00 - Facility Water Distribution: Supply connections to domestic water heaters.
 - 3. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.2 REFERENCES

- A. These standards shall be considered as minimum requirements. This is a general list and not all standards listed are necessarily referenced elsewhere in this Section. Specific requirements of this Section and/or Drawings shall have precedence. The Architect shall resolve conflicts between published requirements.

- B. Titles and abbreviation of Federal, State and industry standards, technical societies, associations and institutes and other organizations, which may be used, are as follows:
 - 1. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - a. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 2. American Society of Mechanical Engineers:
 - a. ASME PTC 25 - Pressure Relief Devices.
 - b. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

- B. Shop Drawings: Indicate heat exchanger dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.

- C. Product Data: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Submit electrical characteristics and connection locations.

- D. Manufacturer's Installation Instructions: Submit mounting and support requirements.

- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.5 QUALITY ASSURANCE

- A. Conform to ASME Section VIII for construction of water heaters. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.
- B. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1.
- C. Perform Work in accordance with the city of [Insert town/city, state of project] work standards.
- D. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Products storage and handling requirements.
- B. Accept water heaters on site in original labeled cartons. Inspect for damage.
- C. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five-year manufacturer warranty for domestic water heaters and water storage tanks.

PART 2 PRODUCTS

2.1 GENERAL NOTES

- A. Furnish materials in accordance with city of [Insert town/city, state of project] standards.

2.2 COMMERCIAL ELECTRIC WATER HEATERS

- A. Type: Factory-assembled and wired, electric, vertical storage.
- B. Capacity:
 - 1. As indicated on drawings.
- C. Tank: Glass lined welded steel; 4-inch diameter inspection port, thermally insulated with minimum 2 inches polyurethane encased in corrosion-resistant steel jacket; baked-on enamel finish.
- D. Tank: Welded steel ASME labeled pressure vessel; glass lining, mounted on steel channel base with lifting lugs, insulated with 2-inch glass fiber; enclosed with 16-gage steel jacket; baked enamel finish.
- E. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
- F. Controls: Ventilated control cabinet, factory-wired with solid state progressive sequencing step controller, fuses, magnetic contactor, control transformer, pilot lights indicating main power and heating steps, control circuit toggle switch, electronic low-water (probe-type) cut-off, high temperature limit thermostat, flush-mounted temperature and pressure gages.
- G. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.
- H. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 Watts per square inch.
- I. Manufacturer: Bradford White, John Wood, AO Smith, Rheem or acceptable alternative.

2.3 TANKLESS ELECTRIC WATER HEATERS

- A. Type: Thermostatic-Control, Electric, Tankless, Domestic-Water Heaters
- B. Capacity:
 - 1. As indicated on drawings.
- C. Standard: ULC 499 for electric, tankless, (domestic-water heater) heating appliance.
- D. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.

- E. Connections: ASME B1.20.1 pipe thread.
- F. Pressure Rating: 150 psig
- G. Heating Element: Resistance heating system.
- H. Temperature Control: Thermostat.
- I. Safety Control: High-temperature-limit cutoff device or system.
- J. Jacket: Aluminum or steel with enameled finish or plastic.
- K. Support: Bracket for wall mounting.

2.4 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics: As indicated on drawings.
- B. Disconnect Switch: Factory mount disconnect switch in on equipment.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Maintain manufacturer's recommended clearances around and over water heaters.
- B. Install water heater on concrete housekeeping pad, minimum 3-1/2 inches high and 6 inches larger than water heater base on each side. Refer to Section 03 30 00.
- C. Connect domestic hot water piping to supply and return water heater connections.
- D. Install the following piping accessories. Refer to Section 22 11 00.
 - 1. On supply:
 - a. Thermometer well and thermometer.
 - b. Strainer.
 - c. Pressure gage.
 - d. Shutoff valve.
 - 2. On return:
 - a. Thermometer well and thermometer.
 - b. Pressure gage.
 - c. Shutoff valve.
- E. Install discharge piping from relief valves and drain valves to nearest floor drain for tank style water heaters.

- F. Install water heater trim and accessories furnished loose for field mounting.
- G. Install electrical devices furnished loose for field mounting.
- H. Install control wiring between water heater control panel and field mounted control devices.

END OF SECTION 22-33-00

Plumbing Fixtures

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
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SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water closets.
2. Bidets.
3. Urinals.
4. Lavatories.
5. Sinks.
6. Service sinks.
7. Electric water coolers.
8. Drinking fountains.
9. Bathtubs.
10. Showers.
11. Wash fountains.
12. Emergency showers.
13. Emergency Eye and Face Wash.
14. Emergency Combination Shower with Eye and Face Wash.

B. Related Sections:

1. Section 07 90 00 - Joint Protection: Product requirements for calking between fixtures and building components for placement by this section.
2. Section 22 11 00 - Facility Water Distribution: Supply connections to plumbing fixtures.
3. Section 22 13 00 - Facility Sanitary Sewerage: Waste connections to plumbing fixtures.
4. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections to sensor valves and faucets specified by this section.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ANSI Z124.1 - Plastic Bathtub Units.
3. ANSI Z124.2 - Plastic Shower Units.
4. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.

B. Air-Conditioning and Refrigeration Institute:

1. ARI 1010 - Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.

C. American Society of Mechanical Engineers:

1. ASME A112.6.1 - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
2. ASME A112.18.1 - Plumbing Fixture Fittings.
3. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
4. ASME A112.19.2M - Vitreous China Plumbing Fixtures.
5. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).

6. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
7. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Installation Instructions: Submit installation methods and procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 1. Water Efficiency Certificates:
 - a. Certify plumbing fixture flow rates.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with KY City of Ashland standards.
- B. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc., as suitable for purpose specified and indicated.
- C. Provide plumbing fixture fittings in accordance with ASME A112.18.1 that prevent backflow from fixture into water distribution system.
- D. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.8 MOCKUP

- A. Section 01 40 00 - Quality Requirements: Mockup requirements.
- B. Construct mockup of typical bathroom group.
- C. Locate where indicated on Drawings.
- D. Incorporate accepted mockup as part of Work.

1.9 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept fixtures on site in factory packaging. Inspect for damage.
- C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five-year manufacturer warranty for plumbing fixtures.

1.12 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two flush valve service kits, lavatory supply fittings, shower heads toilet seats.

PART 2 PRODUCTS

2.1 WATER CLOSETS

- A. WC-1 – Flush Tank, Floor Mounted
 - 1. Kohler, K-3978 “Wellworth”, Vitreous China, White, Supply: K-7637, Seat: K-4688
- B. WC-2 – ADA Flush Tank, Floor Mounted
 - 1. Kohler, K-3979 “Highline”, Vitreous China, White, Supply: K-7637, Seat: K-4731-C-O
- C. WC-3 – Flush Valve, Wall Mounted

1. Kohler, K-4325 “Kingston”, Vitreous China, White, Flush Valve: K-10957 1.6 GPF Automatic Flush Valve, Seat: K-4731, Carrier: Josam Series 12000 Adjustable carrier Installed to meet design requirements

2.2 Lavatories

- A. L-1 – ADA Lavatory, Wall Hung
 1. Kohler, K-1722 “Chesapeake”, Vitreous China, White, Supplies: K-7605-P, P-trap: K-8998 & K-7131-A Offset Drain, Faucet: K-13460, Drain: K-7129-A Grid Drain, Carrier: Josam Series #17100 Floor Mount Carrier
- B. L-2 – ADA Lavatory, Drop-In
 1. Kohler, K-2196-4 “Pennington”, Vitreous China, White, Supplies: K-7605-P, P-trap: K-8998, Faucet: K-15243-4 (Including Grid Drain)

2.3 Urinals

- A. UR-1 – Blowout Urinal, Wall Hung
 1. Kohler, K-4972-ET “Stanwell”, Vitreous China, White, Flush Valve: K-13522 1.0 GPF manual flush, Carrier: Josam #17550-UR Floor Mounted Carrier
- B. UR-2 – ADA Blowout Urinal, Wall Hung
 1. Kohler, K-4972-ET “Stanwell”, Vitreous China, White, Flush Valve: K-13522 1.0 GPF manual flush, Carrier: Josam #17550-UR Floor Mounted Carrier

2.4 Bath and Showers

- A. BT-1 – Bath Tub, 3-Wall Alcove
 1. Kohler, K-1510-X “Hourglass”, Acrylic, White, Drain: K-7161-AF Pop-Up Drain, Trim: K-T10335-4 Bath Valve Trim, K-10337 Non-diverter Spout, K-15701-K Pressure Balancing Valve
- B. SH-1 – Shower Unit, 32” Wide Module
 1. Kohler, K-1689 “Sonata”, FRP, White, Drain: K-9132-CP Grid Drain, Trim: K-9881-B Pivot Door, K-T15872-4K-CP Wall Mount Shower, K-15701-K Pressure Balancing Valve
- C. SH-2 – Barrier-Free Shower Unit, 56” Wide Module
 1. Kohler, K-12113 “Freewill”, Acrylic, White, Drain: K-9132-CP Grid Drain, Trim: K-704014 Panel Door, K-T8228-4/K-304-K Adjustable shower set W/ Pressure Balancing Valve
- D. SH-3 – ADA Build-Up Shower
 1. Kohler, Drain: K-9132-CP Grid Drain, Trim: K-704014 Panel Door, K-T8228-4/K-304-K Adjustable shower set W/ Pressure Balancing Valve

2.5 Utility Sinks

- A. MS-1 – Mop Sink, Floor Mounted

1. Elkay, EFS2523C, #302 Stainless Steel, Satin, Faucet: T&S Brass #B-0695-ST Faucet W/ Vb @ 90" Aff, Drain: Lk-43 Open Grid Strainer, Accessories: Lk-402 Hose, Lk-403 Mop Hanger, Lk-404 Hose Hanger
- B. MS-2 – Mop Sink, Floor Mounted
 1. Elkay, EFS3321C, #302 Stainless Steel, Satin, Faucet: T&S Brass #B-0695-ST Faucet W/ Vb @ 90" Aff, Drain: Lk-43 Open Grid Strainer, Accessories: Lk-402 Hose, Lk-403 Mop Hanger, Lk-404 Hose Hanger
- C. MS-3 – Mop Sink, Floor Mounted
 1. Zurn, Z1996-36, High Density Composite
- D. MS-4 – Mop Sink, Floor Mounted
 1. Fiat Products, TSBC6010, Terrazzo, Grey, Faucet: T&S Brass #B-0695-ST Faucet W/ Vb @ 90" Aff, Accessories: T&S Brass #B-0695-St Faucet W/ Vb @ 90" Aff, 830AA Mop Service Basin Fitting, 832AA Hose & Hose Bracket, 833AA Silicone Sealant, Msg Wall Guards.
- E. MS-5 – Mop Sink, Floor Mounted
 1. Fiat Products, TSB-700, Terrazzo, Grey, Faucet: T&S Brass #B-0695-ST Faucet W/ Vb @ 90" Aff, Accessories: T&S Brass #B-0695-St Faucet W/ Vb @ 90" Aff, 830AA Mop Service Basin Fitting, 832AA Hose & Hose Bracket, 833AA Silicone Sealant, Msg Wall Guards.
- F. MS-6 – Mop Sink, Floor Mounted
 1. Fiat Products, TSB-300, Terrazzo, Grey, Faucet: T&S Brass #B-0695-ST Faucet W/ Vb @ 90" Aff, Accessories: T&S Brass #B-0695-St Faucet W/ Vb @ 90" Aff, 830AA Mop Service Basin Fitting, 832AA Hose & Hose Bracket, 833AA Silicone Sealant, Msg Wall Guards.

2.6 Drinking Fountains and Water Coolers

- A. DF-1 – ADA Drinking Fountain – SGL, Wall Mounted
 1. Elkay, EDFP-214-C, #302 Stainless Steel, Satin, Carrier: MPW101 Carrier, Accessories: ML100 Support Column
 2. Provide with Service Stop, and wall plate
- B. DF-2 – ADA Drinking Fountain – DBL
 1. Elkay, EDFP-217-C, #302 Stainless Steel, Satin, Dual Height Unit, MPW200 Carrier, ML100 Support columns,
 2. Provide with Service Stop
 3. MP20 Mounting plate, and wall plate
- C. EWC-1 – ADA Water Cooler – SGL
 1. Elkay, EMABF8, Steel, Gray Beige
 2. Provide with service stop, 1' ¼" trap
- D. EWC-2 – ADA Water Cooler – DBL
 1. Elkay, EMABFTL8C, Steel, Gray Beige, Dual Height Unit

2. Provide with service stop, 1' ¼" trap
- E. EWC-3 – ADA Filtered Water Cooler – SGL
1. Elkay, LMABF8, Steel, Gray Beige
 2. Provide with service stop, 1' ¼" trap
- F. EWC-4 – ADA Filtered Water Cooler – DBL
1. Elkay, LMABFTL8C, Steel, Gray Beige, Dual Height Unit
 2. Provide with service stop, 1' ¼" trap
- 2.7 Kitchen Sinks / Service Sinks
- A. KS-1 – 1-Bowl Kitchen Sink, Drop-In
1. Elkay, LCGR-2522, #302 Stainless Steel, Satin, Faucet: LK-4350-F W/Spray, Accessories: LK-35 Basket Strainer
- B. KS-2 – 2-Bowl Kitchen Sink, Drop-In
1. Elkay, LCR-3322, #302 Stainless Steel, Satin, Faucet: LK-4391-F W/Spray, Accessories: (2) LK-35 Basket Strainer
- C. SS-1 – Deep 1-Bowl Service Sink, Drop-In
1. Elkay, DLR-1722-10, #302 Stainless Steel, Satin, Faucet: LK-2432, Accessories: LK-18 Open Grid Strainer
- D. SS-2 – Deep 2-Bowl Service Sink, Drop-In
1. Elkay, DLR-3322-10, #302 Stainless Steel, Satin, Faucet: LK-2432, Accessories: (2) LK-18 Open Grid Strainer
- E. SS-3 – X-Deep 1-Bowl Service Sink, Drop-In
1. Elkay, DLR-3322-12, #302 Stainless Steel, Satin, Faucet: LK-4301-F Faucet w/ Spray, Accessories: LK-35 Basket Strainer
- F. SS-4 – Scrub-Up Sink, Wall Mounted
1. Elkay, EWS-2520-F-C, #304 Stainless Steel, Satin, Accessories: All required accessories included, double pedal action valve
- G. FSS-1 – 3-Compartment Scullery Sink, Floor Mounted
1. #304 Stainless Steel, Stain,
 2. Furnished by restaurant equipment vendor
 3. Provide indirect waste to floor sink
- H. FSS-2 – Vegetable Sink, Floor Mounted
1. #304 Stainless Steel, Stain,
 2. Furnished by restaurant equipment vendor
 3. Provide indirect waste to floor sink
- I. FSS-3 – Chef's Prep Sink, Drop-In
1. Size: Coordinate with [Arch, Owner or Owners Representative on size and style of fixture]
 2. #304 Stainless Steel, Stain,

3. Furnished by restaurant equipment vendor
4. Provide indirect waste to floor sink

J. FSS-4 – Bar Sink, Drop-In

1. Size: Coordinate with [Arch, Owner or Owners Representative on size and style of fixture]
2. #304 Stainless Steel, Stain,
3. Furnished by restaurant equipment vendor
4. Provide indirect waste to floor sink

K. FSS-5 – 4-Compartment Sink, Drop-In

1. Size: Coordinate with [Arch, Owner or Owners Representative on size and style of fixture]
2. #304 Stainless Steel, Stain,
3. Furnished by restaurant equipment vendor
4. Provide indirect waste to floor sink

L. FSS-6 – Pre-Wash Sink, Integral

1. Size: Coordinate with [Arch, Owner or Owners Representative on size and style of fixture]
2. #304 Stainless Steel, Stain,
3. Furnished by restaurant equipment vendor
4. Provide indirect waste to floor sink

M. HS-1 – Food Service Hand Sink, Wall Mounted

1. Elkay, CHS-1716-C, #304 Stainless Steel, Stain, Faucet: LK-499 Splash Mount, Accessories: LK-8 Grid Drain, LK-500 P-trap w/ Cleanout

N. HS – 1-Bowl Hospitality Sink, Drop-in

1. Elkay, BLR-150C, #302 Stainless Steel, Satin
2. Sink Package Includes: LKA-2223 Centerset Faucet, LK-36 Basket Strainer

2.8 Emergency Shower / Eyewash

A. EEW – Emergency Eyewash, Wall Mounted

1. Guardian, G-1814, #304 Stainless Steel, Waste Attachment Optional

2.9 Bibbs

A. FPWH - Freezeproof Wall Hydrant, Wall Mounted

1. Josam, 71000, Bronze, Nikaloy Satin, Integral Vacuum Breaker, Spare Control Key

2.10 Utility Boxes / Connections

A. UB-1 – Ice Maker Utility Box, Wall Mounted

1. Guy Gray, BIM875, Steel, Field Painted
2. Mounting Height May Be Adjusted to Suit Field Conditions

B. UB-2 – Laundry Utility Box

1. Guy Gray, T200, Steel, White Enamel
2. Mounting Height May Be Adjusted to Suit Field Conditions

- C. UB-3 – Wall-Mounted Indirect Drain
 - 1. Sioux Chief, 690-3, ABS, White
 - 2. 696-CF Drainage Funnel, Mounting Height May Be Adjusted to Suit Field Conditions
- D. DWC – Domestic Dishwasher Connection
 - 1. HW & Waste Connected to adjacent kitchen sink with DW Fittings.
 - 2. Connection specified by Dishwasher Manufacturer

2.11 ELECTRICAL

- A. Provide transformer for all automatic faucets and flush valves

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install Work in accordance with [State/city], standards.
- B. Install each fixture with trap, easily removable for servicing and cleaning.
- C. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- D. Install components level and plumb.
- E. Install and secure fixtures in place with wall carriers and bolts.
- F. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 90 00, color to match fixture.
- G. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

H. For ADA accessible water closets, install flush valve with handle to wide side of stall.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Do not permit use of fixtures before final acceptance.

END OF SECTION 22-40-00

Common Motor Requirements for HVAC Equipment - Motor Starters

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

SECTION 23 05 13 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT – MOTOR STARTER

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 ac, enclosed controllers rated 600 V and less, of the following types:
 - 1. Across-the-line, manual and magnetic controllers.
 - 2. Reduced-voltage controllers.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical Power Monitoring and Control" for interfacing communication and metering requirements.
 - 2. Division 26 Section "Transient Voltage Suppression" for low-voltage power, control, and communication surge suppressors.

1.3 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each enclosed controller.
 - 1. Include 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. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current rating of integrated unit.
 - d. Listed and labeled for series rating of overcurrent protective devices in combination controllers by an NRTL acceptable to authorities having jurisdiction.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- D. Qualification Data: For manufacturer.

- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for enclosed controllers and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- G. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.
- C. 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.
- D. Comply with NFPA 70.
- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.6 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

- C. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.7 EXTRA MATERIALS

- 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. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
 - 2. Indicating Lights: Two of each type installed.

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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
 - 2. Siemens/Furnas Controls.
 - 3. General Electrical Company; GE Industrial Systems.
 - 4. Or approved equal.

2.2 REDUCED VOLTAGE ENCLOSED CONTROLLER

- A. Solid-State, Reduced-Voltage Controller: NEMA ICS 2, suitable for use with NEMA MG 1, Design B, poly-phase, medium induction, 25 HP motors and larger.
 - 1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds.
 - 2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 - 3. LED indicators showing motor and control status, including the following conditions:
 - a. Control power available.
 - b. Controller on.
 - c. Overload trip.
 - d. Loss of phase.
 - e. Shorted silicon-controlled rectifier.
 - 4. Motor running contactor operating automatically when full voltage is applied to motor.

2.3 ENCLOSURE

- A. Description: Flush or surface-mount cabinets as indicated. NEMA Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
 - 1. Outdoor Locations: Type 4X, stainless steel.
 - 2. Kitchen Areas: Type 4X, stainless steel.

3. Other Wet or Damp Indoor Locations: Type 4.

2.4 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights, and HOA Selector Switches: NEMA ICS 2, heavy-duty type.
- C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- D. Control Relays: Auxiliary and adjustable time-delay relays.
- E. Elapsed Time Meters: Heavy duty with digital readout in hours.
- F. Phase-Failure and Under-voltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable under-voltage setting.
- G. Current-Sensing, Phase-Failure Relays for Bypass Controllers: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.5 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and tested enclosed controllers before shipping.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Electrical Supports"
- B. Install freestanding equipment on concrete bases.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Electrical Supports"
- D. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.4 IDENTIFICATION

- A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Electrical Identification."

3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers according to Division 26 Section "Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.7 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.

C. Report results in writing.

3.8 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 23-05-13

Vibration and Seismic Controls for HVAC

Reason for Issue: Construction Specifications

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
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SECTION 23 05 48 – VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Requirements of Section 01 including, but not limited to, General Requirements, Submittal Procedures, Quality Requirements, Product Requirements, Substitution Procedures, Operation and Maintenance Data, Demonstration and Training shall apply to all work under this section.
- B. This section provides minimum acceptance requirements for vibration isolation for all mechanical equipment, ductwork and piping.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Requirements of Section 01 apply to all work under this section.
- B. Concrete work is provided in Section 03.
- C. Ductwork flexible connections are specified elsewhere in Section 23.
- D. Vibration isolation for electrical systems is provided in Section 26.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.
- D. ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers.
- E. OSHA: Occupational Safety and Health Administration.

1.4 QUALITY ASSURANCE

- A. Unless otherwise directed by the local authority having jurisdiction, the following codes and standards will apply:
 - 1. 2009 International Building Code
 - 2. American Society of Civil Engineers 7-05
 - 3. Manufacturer's Standardization Society MSS-58-2002
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 SUBMITTALS

- A. All vibration isolation systems shall be by one manufacturer. Approved vibration isolation manufacturers are as follows:
 - 1. Vibro-Acoustics.
 - 2. Mason Industries.
 - 3. Amber-Booth
 - 4. Or approved equal.
- B. Submit shop drawings for all devices specified herein and as indicated on the drawings. Submittals shall include dimensions, materials, attachment and anchorage requirements. Indicate compliance with each specification item herein.
- C. Delegated-Design Submittal: For vibration isolation details 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 static and/or dynamic loading due to equipment weight and operation to select vibration isolators and for designing vibration isolation bases.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure and spring deflection changes. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
- D. Welding certificates.
- E. Qualification Data: For professional engineer and testing agency.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATORS AND MOUNTINGS

- A. General
 - 1. Unless otherwise specified in this Division all machinery or vibrating mechanical equipment shall be isolated from the building structure by vibration isolators with a minimum deflection as specified. Operating equipment that can transmit objectionable vibration and noise must be installed with special types of vibration isolators such as flexible connectors to ductwork, piping and wiring. In more critical areas and under particular conditions, additional vibration isolators shall be installed as specified in other related Sections in this Division, or in specific equipment schedules.
 - 2. All equipment shall be provided with attachment points for floor or suspended mounting that will safely transmit all loads to the supports.

3. The vibration isolator manufacturer shall be responsible for the proper selection of vibration isolators suitable for the particular application. Selection of the vibration isolator shall include the following factors:
 - a. Equipment Weight
 - b. Equipment operating frequencies
 - c. Type of building support structure
4. Unless otherwise noted, vibration isolators shall be furnished by the vibration isolation manufacturer.
5. All floor mounted vibration isolators shall be bolted to the floor or framing on which they rest. Bolts shall be arranged to prevent transmission of vibration through the bolts.
6. All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. All springs except internal nested springs shall have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs shall be square and ground for stability. Laterally stable springs shall have k_x/k_y ratios of at least 0.9. All springs shall be fully color-coded to indicate capacity – color striping is not considered adequate.
7. Bases shall be of welded construction with cross members to form an integral support platform. Structural steel members shall be designed to match supported equipment. Vibration bases for fans shall have adjustable motor slide rails, and shall accommodate motor overhang. Bases for exterior use shall be painted or hot-dipped galvanized for complete corrosion resistance.
8. All isolation devices for a single piece of equipment shall be selected for a uniform static deflection according to distribution of weight in the equipment.
9. All pieces of equipment that have a variation in weight during operation or maintenance such as, but not limited to, cooling towers, shall have built-in vertical limit restraints to limit motion to a maximum of 1/4-in.
10. Isolators exposed to the weather or in damp, wet, or corrosive environments shall be provided with corrosion protection. Steel parts other than springs shall be hot-dipped galvanized. Parts subject to wear, rubbing, shall be non-corrosive material such as rubber or stainless steel. Springs and hardware shall be cadmium plated or otherwise provided with an approved coating.
11. After installation of equipment, isolators shall be adjusted for proper loading and distribution of weight.
12. Select and locate vibration isolation equipment to give uniform loading and deflection, according to weight distribution of equipment.
13. Unless otherwise noted, minimum static deflection for spring-type isolators shall be 1 inch.
14. Unless otherwise noted, all internally isolated air handling units shall be provided with minimum 1" thick, oil resistant, solid neoprene pads. Pads shall be located between the air handling unit base rail and the emergency drain pan.
15. Air handling units with independently mounted fan sections shall be provided with tension adjustable thrust restraints to counteract reaction forces due to air flow. Restraints shall be arranged to allow a maximum 1/4-in of motion at start-up or shutdown.
16. Floor mounted fans shall be provided with structural steel vibration bases common to both fan and motor. Slab-on-grade installations shall be provided with spring-type isolators with a minimum 1" static deflection. Above-grade installations shall be provided with spring-type isolators with a minimum 2" static deflection. There shall be a minimum operating clearance of 1" between each steel base and the structure.
17. All in-line pumps shall be mounted on concrete-filled inertia bases. Concrete in-fill shall be supplied by the installing contractor on site. Inertia bases shall be arranged with spring

isolator locations such that a horizontal plane passing through the top of the isolators will pass through or above the center of gravity of the equipment and base. Slab-on-grade installations shall be provided with spring-type isolators with a minimum 1" static deflection. Above-grade installations shall be provided with spring-type isolators with a minimum 2" static deflection. There shall be a minimum operating clearance of 2" between each inertia base and its foundation.

18. Engine-generator sets shall be supported with spring-type isolators with a minimum 3" static deflection. There shall be a minimum operating clearance of 2" between each inertia base and its foundation.
19. Engine-generator set silencers and associated exhaust piping shall be supported with spring-type isolators with a minimum 1.5" static deflection.
20. Skid-mounted air compressors shall be supported with housed spring-type isolators. Slab-on-grade installations shall be provided with spring-type isolators with a minimum 1" static deflection. Above-grade installations shall be provided with spring-type isolators with a minimum 2" static deflection.
21. Extent of Piping Isolation:
 - a. Isolate all piping between 2" and 10" dia. and directly connected to motorized and/or vibration isolated equipment with 1" static deflection spring hangers.
 - b. Isolate all piping larger than 10" dia. and directly connected to motorized and/or vibration isolated equipment with 2" static deflection spring hangers.
 - c. Spring hangers shall be spaced at intervals in accordance with the following:

| Pipe Diameter | Distance from Vibrating Equipment |
|---------------|-----------------------------------|
| 2" to 4" | 50' |
| 6" and 8" | 60' |
| 10" Larger | 70' |

- d. Condenser, and Domestic Cold and Hot Water Piping:
 - 1) Horizontal:
 - a) Pipe stand supports shall be supported on isolators. The first 3 isolators shall have the same minimum static deflection as the equipment isolators. The remaining isolators shall have a minimum 1" static deflection.
 - b) Piping shall be suspended with isolators. The first 3 hangers shall have the same minimum static deflection as the equipment isolators, with a maximum of 2". The remaining isolators shall have a minimum 1" static deflection.
 - 2) Vertical:
 - a) Piping shall be isolated from the supporting members or structure with isolators with a minimum 1" static deflection.
22. Extent of Ductwork Isolation:
 - a. Provide vibration isolation for ductwork as required.
 - b. Floor-supported ductwork shall be isolated from the structure with isolators with minimum 1" static deflection.
23. There shall be no direct contact of isolated piping, ductwork, or equipment with shaft walls, floor slabs, partitions, or conduits.

24. Provide height saving brackets where recommended by the manufacturer for equipment stability, or operating height requirements.
25. Where recommended by the manufacturer, isolator base plates shall be bolted to the structure or foundation. Bolting shall incorporate neoprene bushings and washers.
26. Provide spring-loaded thrust restraints for fans and air handling units where movement under any operating condition will exceed 0.375".
27. Isolation hangers shall be installed with the housing a minimum of 1/4" below but as close to the structure as possible. Where isolator hangers would be concealed by non-accessible acoustical sub ceiling, install the hangers immediately below the sub ceiling for access.

B. Vibration Isolation Types

1. Isolation Types for Floor Mounting

- a. Single elastomer-in-shear isolators, molded mound shaped element designed for 1/4-in deflection under the imposed static load. Double elastomer-in-shear isolators shall be two such elements assembled in series or a molded element designed to provide 1/2-in deflection under the imposed static load. Elastomer-in-shear isolators shall be properly housed to prevent bulging and shall be provided with adequate facilities for bolting to equipment and floor slab.
- b. Spring isolators shall be free standing and laterally stable and shall be equipped with acoustical-friction pads, leveling bolts and bolt holes for anchoring to floor slab. Springs shall have a minimum ratio of outside diameter to operating spring height of 0.8 and an additional travel to solid equal to 50 percent of the specified deflection. Where housed springs are specified or required, provide units with telescoping cast iron or steel housing, containing one or more springs, complete with resilient alignment insert and a minimum of 1/4" thick rubber or neoprene sound deadening pad bonded to the base of housing. Spring isolators shall have a minimum overload capacity of 200 percent of rated load, fully compressed, without deformation or failure.
- c. Heavy load pads shall be minimum 1-1/4" thick and shall consist of a high load capacity elastomer pad and sandwiched between two 1/8-in thick steel load distribution plates capable of supporting loads up to 250 psf. For large pad area, steel plates of suitable thickness shall be provided to distribute the load.
- d. Light load pads shall be minimum 3/4" thick solid neoprene corrugated single or laminated double, oil resistant neoprene. Pads shall be capable of loading to 50 psf.

2. Isolation Types for Suspension

- a. Isolation hangers for suspension of equipment and piping shall have a single element of elastomer for 1/4-in deflection, a double or a single molded element for 1/2-in deflection, a single spring element with an elastomer grommet for 3/4-in deflection and a combination of an elastomer and spring elements in series for a deflection of 1" and above; elastomer and spring elements shall be contained within a structural rigid one piece steel hanger box. Springs shall have a minimum ratio of outside diameter to operating spring height of 0.8 and an additional travel to solid equal to 50 percent of the specified deflection.
- b. The neoprene element shall have a bushing to prevent hanger rod contact with the housing box. The lower rod shall be free to swing in a 30 degree arc without touching the spring or the housing.

3. Rails and Bases - Rails and bases shall be of the following types based on the equipment and deflection required.

- a. Rubber in shear type shall be steel rails running the full length of the supported equipment and extending under any overhang to counteract cantilever effects. The rails

- shall incorporate single or double deflection elastomer-in-shear fastened in place and a continuous steel floor bearing plate running the full length of each rail. The rails shall be drilled and tapped to accept the supported equipment and shall serve as a template.
- b. Steel spring type shall be steel rails running the full length of the supported equipment and extending under any overhang to counteract cantilever effects. The rails shall consist of structural members supported by individual free standing springs. The rails shall be drilled to accept the supported equipment and shall serve as a template.
 - c. Fans and their driving motors shall be mounted on structural steel channel members forming a rigid base. A common member, parallel to the V-belt drive, shall run the full length of the fan and motor and shall be of sufficient rigidity to resist the bending stress of belt pull. The structural steel base shall incorporate single or double deflection elastomer-in-shear elements or free standing springs located for proper weight distribution. The base shall be drilled and tapped to accept the fan and motor and shall serve as a template. Integral motor slide rails shall be provided and welded in place.
 - d. Inertia bases shall be of welded steel construction with concrete in-fill supplied by the installing contractor on site and shall incorporate 15M (No.4) reinforcing bars, welded 12" maximum on centers each way.
 - 1) Inertia bases for pumps shall be of sufficient size to accommodate supports for pipe elbows at pump suction and discharge connections.
 - 2) Inertia bases for fans shall include motor slide rails.
 - 3) The weight of each inertia base shall be at least equal to the weight of the equipment mounted thereon or sufficient to lower the center of gravity to or below the isolator support plane.
 - 4) Inertia bases shall be a minimum of 6" thick.
 - 5) Height-saving brackets or welded steel pockets shall be incorporated to maintain a 1" minimum clearance under each inertia base.
 - 6) Wooden formed bases leaving a concrete rather than a steel finish are not acceptable.
4. Isolation for Piping
- a. Flexible piping for systems with operating temperatures over 200 degrees F shall be stainless steel braided annular flexible hose. The hose shall be provided with an external stainless steel braid to minimize elongation under pressure. Hoses 2-1/2-in and smaller shall be threaded and hoses 3-in and larger shall be flanged. Flanged hoses shall be provided with a fixed, raised plate flange on one end and a floating flange on the other. The manufacturer shall confirm the suitability of the flexible piping for the temperature and pressure of the systems.
 - b. Rubber expansion joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14" shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Provide control cables to prevent excessive elongation on straight connection where required. The manufacturer shall confirm the suitability of the connections for the temperature, pressure, and pipe contents for the systems.

Minimum ratings through 14" shall be 250psi at 170°F and 215psi at 250°F. 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required.

Safety factors shall be a minimum of 3/1. All expansion joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment.

The piping gap shall be equal to the length of the expansion joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000 psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the expansion joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves.

- c. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes may have male nipples. Minimum lengths shall be as tabulated:

Flanged

| | | |
|------------------------|-------------------------|-------------------------|
| 3" x 12" (75 x 300mm) | 6" x 18" (150 x 450mm) | 12" x 24" (300 x 600mm) |
| 4" x 12" (100 x 300mm) | 8" x 18" (200 x 450mm) | 14" x 30" (350 x 750mm) |
| 5" x 18" (125 x 450mm) | 10" x 18" (250 x 450mm) | 16" x 32" (400 x 800mm) |

Male Nipples

| | | |
|-------------------------|---------------------------|---------------------------|
| 1/2" x 12" (12 x 300mm) | 1-1/4" x 12" (32 x 300mm) | 2" x 12" (50 x 300mm) |
| 3/4" x 12" (19 x 300mm) | 1-1/2" x 12" (38 x 300mm) | 2-1/2" x 18" (64 x 450mm) |
| 1" x 12" (25 x 300mm) | | |

- d. At equipment, hoses shall be installed on the equipment side of the shut-off valves horizontal and parallel to the equipment shafts wherever possible.

C. Rigidly Mounted Equipment

- 1. When equipment doesn't require vibration isolation, it shall be firmly attached to the building structure.

2.2 NOISE CRITERIA

- A. The selection of pumps, fans, air handling equipment, air conditioners, heating ventilating and air conditioning machinery and mechanical equipment and the installation of the system components such as duct work and piping shall be such as not to exceed noise guidelines as defined in Chapter 47 of the 2007 edition of the ASHRAE HVAC Applications Handbook. Under no conditions shall the noise created by equipment exceed the levels of permissible noise exposures of occupational areas as established by the OSHA and other Federal, State and local safety and health standards, codes and ordinances.
- B. The equipment supplier shall provide actual noise data for the equipment submitted. If the space does not meet the required criteria, and the noise level of the equipment is found to be the cause, the equipment supplier shall be responsible for the modifications required to correct the condition.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings
 - 2. All hardware shall be galvanized. Metal components for exterior use shall be hot-dip galvanized.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 EXECUTION

3.1 GENERAL

- A. Coordinate size, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation to ensure adequate space and prevent edge breakout failures.
- B. Coordinate locations and sizes of structural supports with locations of vibration isolators (e.g., roof curbs, cooling towers, air-cooled chillers, etc.).

3.2 VIBRATION ISOLATION

- A. Block and shim all bases level so that all ductwork and piping connections can be made to a rigid system at the proper operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and the building structure.
- B. Ensure housekeeping pads have adequate space to mount equipment and isolator housings and shall also be large enough to ensure adequate edge distance for isolator anchor bolts to avoid housekeeping pad breakout failure.

3.3 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.

- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.

3.4 INSPECTION AND CERTIFICATION

- A. After installation, arrange and pay for the vibration isolation product manufacturer to visit the site to verify that the vibration isolation systems are installed and operating properly. Vibration isolation product manufacturer shall submit a certificate stating that the vibration isolation systems are installed and operating properly.
- B. Verify that isolators are adjusted with springs perpendicular to bases or housing, adjustment bolts are tightened up on equipment mountings, and hangers are not cocked.
- C. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- D. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 3. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 4. Test to 90 percent of rated proof load of device.
 - 5. Measure isolator deflection.
 - 6. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Prepare test and inspection reports.

END OF SECTION 23-05-48

HVAC Testing, Adjusting and Balancing Requirements

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

SECTION 23 05 93 – HVAC TESTING, ADJUSTING AND BALANCING REQUIREMENTS

PART 1 GENERAL

1.1 PROVISIONS

- A. Requirements of Division 01 including, but not limited to, General Requirements, Submittal Procedures, Quality Requirements, Product Requirements, Substitution Procedures, Operation and Maintenance Data, Demonstration and Training shall apply to all work under this section.
- B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration in accordance with Division 01. Those judged to be equal to that specified, will receive written approval.

1.2 DESCRIPTION

- A. Work covered by this Section includes furnishing of and paying for all materials, labor, services, equipment, licenses, taxes, other items, and appliances necessary for the execution, installation and completion of all work specified herein and/or shown on the drawings.
- B. The work described in this section of the specifications includes, but is not limited to, the following:
 - 1. Contractor shall provide air balance report for the existing (as-built) conditions for all HVAC air and water distribution systems serving the third, fourth and sixth floors which will be affected by the renovation project. Report shall include existing equipment and performance data. Equipment, duct and piping layouts shown on drawings are from best available information. Contractor shall field verify actual conditions and submit updated electronic drawings, with TAB report, which identify discrepancies from the contract documents.
 - 2. Replacement of all sheaves and belts for equipment listed in the Lab Exhaust Fan Schedule (Existing) and in the Air Handling Unit Schedule (Existing) after the Pre- Demolition / Pre-Construction conditions are measured and the findings have been assessed by the Architect.
 - 3. Testing, adjusting and balancing of new and existing HVAC systems and equipment to demonstrate proper operation.

1.3 RELATED WORK

- A. The following items of related work are specified and included in other sections of these specifications:
 - 1. Section 20 01 00 - General.
 - 2. Section 23 06 30 - Cleaning Mechanical Systems.
 - 3. Section 23 05 16 - Piping and Fittings.
 - 4. Section 23 05 95 - HVAC Testing, Adjusting and Balancing Procedures

1.4 SUBMITTALS

- A. Submit Air Balance data in accordance with Section 23 05 95.

1.5 COORDINATION

- A. Advise Architect of scheduled systems testing and completed system demonstration/operation schedules so that he may witness, if desired.

1.6 QUALITY ASSURANCE

- A. The TAB (Testing and Balancing) contract shall be between the Contractor and the TAB firm.
- B. All TAB deficiencies shall be corrected when found. Any deficiencies that are (for whatever reason) not corrected immediately shall be shown in the TAB report and listed on a summary sheet in the front of the TAB report. The TAB report must be completed and accepted by the Architect before the project is accepted and all items on the summary sheet shall become punch list items with dollar values assigned to them.
- C. TAB firms shall be certified by either the AABC (Associated Air Balance Council) or the NEBB (National Environmental Balancing Bureau).
- D. Below is a partial list of TAB firms serving the State of Louisiana. This list is provided for reference only. <<<<Add info for the state you project is at.>>>>

| <u>Firm Name</u> | <u>Voice Number</u> | <u>FAX Number</u> |
|---|---------------------|-------------------|
| Coastal Air Balance, Inc. (Metairie) | 504-834-4537 | 504-834-2361 |
| Consolidated Balancing Services (Metairies) | 504-455-4944 | 504-887-1972 |
| Tech Test, Inc. of Louisiana (Baton Rouge) | 225-752- 1664 | 225-752-0295 |
| Acadian Air Balance, Inc. (Lafayette) | 318-237-6494 | 318-237-6463 |
| Certified Balance, Inc. (Monroe) | 318-387-1550 | 318-322-4251 |
| Edmonds Engineering Services (Shreveport) | 318-687-4470 | 318-687-8945 |
| Oxner Engineering (Shreveport) | 318-424-9259 | 318-222-7254 |

- 1. Verification of TAB firm certification may be confirmed by contacting the certification agencies at the telephone numbers shown below:
 - a. NEBB at 301-977-3698
 - b. AABC at 202-737-0202
- E. At the time of final inspection, the TAB agency may be required to recheck, in the presence of the Owner's representative, specific and random selections of data, air quantities, and air motion recorded in the certified report. Points and areas for recheck shall be selected by the owner's representative. Measurements and test procedures shall be the same as approved for the initial work for the certified report. Selections for recheck, specific plus random, shall not exceed 10% of the total number tabulated in the report.

- F. Shop drawings must be provided to the TAB firm no later than 30 days after the final, approved shop drawings have been returned by the Architect to the Contractor.
- G. Coordination between the TAB firm and the Contractor shall be left strictly to those parties.
- H. The Contractor shall conduct pressure tests of supply, return, outside air and exhaust ductwork to quantify the leakage rate of the installed systems. Unless otherwise noted, duct sealing and leakage tests shall be conducted to meet or exceed the minimum requirements per ANSI/ASHRAE/IESNA Standard 90.1-2007, Section 6.4.4.2 "Ducts and Plenum Leakage". Ductwork shall be fabricated and installed in accordance with SMACNA standards.

| DUCT SEAL AND LEAKAGE CLASSES | | |
|---|--|--|
| | Duct Pressure Classification (Rated Static Pressure) | |
| | less than 3 in.w.g. | 3 in.w.g. and above |
| Required Seal Class | B | A |
| Required Sealing | All traverse joints and longitudinal seams. | All traverse joints, longitudinal seams and duct wall penetrations |
| Required Leakage Class Rectangular Metal | 6 | 6 |
| Required Leakage Class Round Metal | 3 | 3 |

- I. Fire and smoke damper testing shall be done by the Contractor and witnessed by the TAB firm.

PART 2 PRODUCTS

2.1 INSTRUMENTS

- A. All instruments used by the Air Balancer shall be accurately calibrated within the past calendar year and maintained in good working order

PART 3 EXECUTION

3.1 TESTING – GENERAL

- A. Test existing systems and equipment installed to demonstrate proper operation.
- B. Test new systems and equipment installed to demonstrate proper operation.

- C. Submit notices of readiness for testing to Architect and other appropriate people.
- D. Correct and retest work found defective when tested.
- E. Make repairs to air and water systems with new materials. Peening, doping or caulking of joints or holes will not be acceptable.

3.2 AIR SYSTEMS AND AIR DISTRIBUTION TEST AND BALANCE

- A. Perform HVAC system test and balance in accordance with Section 23 0595.

3.3 CONDENSATE DRAIN PIPING

- A. Test plug opening to permit system to be filled with water to drain pan level. System shall hold water for four hours with no drop in water level.

3.4 RECORDS OF TESTING

- A. Maintain records of system testing and results thereof. Deliver to Architect as part of the maintenance and operation manual

END OF SECTION 23-05-93

HVAC Insulation

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. HVAC piping insulation, jackets and accessories.
2. HVAC equipment insulation, jackets and accessories.
3. HVAC ductwork insulation, jackets, and accessories.

B. Related Sections:

1. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
2. Section 09 90 00 - Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.

1.2 REFERENCES

A. ASTM International:

1. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
2. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
5. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
6. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
7. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
8. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
9. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
10. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
11. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
12. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
13. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
14. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
15. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
16. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

17. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
18. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
19. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
20. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
21. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
22. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
23. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
24. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

B. Sheet Metal and Air Conditioning Contractors’:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. Underwriters Laboratories Inc.:

1. UL 1978 - Standard for Safety for Grease Ducts.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Samples: Submit two samples of representative size illustrating each insulation type.
- D. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 450 in accordance with ASTM E84.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Duct insulation, Coverings, and Linings: Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.

E. Perform Work in accordance with KY City of Ashland standards.

F. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years' experience.

1.6 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for man made fiber.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Furnish materials in accordance with the city of Baton Rouge, Louisiana standards.

2.2 PIPE INSULATION

- A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 850 degrees F.
 - 3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
 - 4. Jacket Temperature Limit: minus 20 to 150 degrees F.
- B. TYPE P-2: ASTM C547, molded glass fiber pipe insulation.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 850 degrees F.
- C. TYPE P-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket.
 - 1. Thermal Conductivity: 0.27 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 650 degrees F.
 - 3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
 - 4. Jacket Temperature Limit: minus 20 to 150 degrees F.
- D. TYPE P-4: ASTM C612; semi-rigid, fibrous glass board noncombustible.
 - 1. Thermal Conductivity: 0.27 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 650 degrees F.
- E. TYPE P-5: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.
 - 1. Thermal Conductivity: 0.27 at 75 degrees F.
 - 2. Operating Temperature Range: Range: Minus 70 to 180 degrees F.
- F. TYPE P-6: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.
 - 1. Thermal Conductivity: 0.30 at 75 degrees F.
 - 2. Maximum Service Temperature: 300 degrees F.
 - 3. Operating Temperature Range: Range: Minus 58 to 300 degrees F.
- G. TYPE P-7: ASTM C534, Type I, flexible, nonhalogen, closed cell elastomeric insulation, tubular.
 - 1. Thermal Conductivity: 0.27 at 75 degrees F.
 - 2. Maximum Service Temperature: 250 degrees F.
 - 3. Operating Temperature Range: Range: Minus 58 to 250 degrees F.
- H. TYPE P-8: ASTM C547, Type I or II, mineral fiber preformed pipe insulation, noncombustible.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Maximum Service Temperature: 1200 degrees F.

3. Canvas Jacket: UL listed, 6 oz/sq yd , plain weave cotton fabric treated with fire retardant lagging adhesive.
- I. TYPE P-9: ASTM C591, Type IV, polyisocyanurate foam insulation, formed into shapes for use as pipe insulation.
 1. Density: 4.0 pounds per cubic foot.
 2. Thermal Conductivity: 180 day aged value of 0.19 at 75 degrees F.
 3. Operating Temperature Range: Range: Minus 297 to 300 degrees F.
 4. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied film of 6 mils thickness and water vapor permeance of 0.02 perms.
- J. TYPE P-10: ASTM C578, Type XIII, extruded polystyrene insulation, formed into shapes for use as pipe insulation.
 1. Thermal Conductivity: 180 day aged value of 0.259 at 75 degrees F.
 2. Operating Temperature Range: Range: Minus 297 to 165 degrees F.
 3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied film of 6 mils thickness and water vapor permeance of 0.02 perms.
- K. TYPE P-11: ASTM C533; Type I, hydrous calcium silicate pipe insulation, rigid molded white; asbestos free.
 1. Thermal Conductivity: 0.45 at 200 degrees F.
 2. Operating Temperature Range: 140 to 1200 degrees F.

2.3 PIPE INSULATION JACKETS

- A. Vapor Retarder Jacket:
 1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
 2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
- B. PVC Plastic Pipe Jacket:
 1. Product Description: ASTM D1785, one piece molded type fitting covers and sheet material, off-white color.
 2. Thickness: 15 mil.
 3. Connections: Brush on welding adhesive.
- C. ABS Plastic Pipe Jacket:
 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 2. Minimum service temperature: -40 degrees F.
 3. Maximum service temperature of 180 degrees F.
 4. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
 5. Thickness: 30 mil.
 6. Connections: Brush on welding adhesive.
- D. Aluminum Pipe Jacket:
 1. ASTM B209, ASTM B209M.
 2. Thickness: 0.020 inch thick sheet.
 3. Finish: Smooth.
 4. Joining: Longitudinal slip joints and 2 inch laps.
 5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

6. Metal Jacket Bands: 1/2 inch wide; 0.015 inch thick aluminum.

E. Stainless Steel Pipe Jacket:

1. ASTM A240/A240M OR ASTM 666 Type 304 stainless steel.
2. Thickness: 0.016 inch thick.
3. Finish: Smooth.
4. Metal Jacket Bands: 1/2 inch wide; 0.010, 0.020 inch thick stainless steel.

F. Field Applied Glass Fiber Fabric Jacket System:

1. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
2. Glass Fiber Fabric:
 - a. Cloth: Untreated; 9 oz/sq yd weight.
 - b. Blanket: 1.0 lb/cu ft density.
 - c. Weave: 10 x 10.
3. Indoor Vapor Retarder Finish:
 - a. Cloth: Untreated; 9 oz/sq yd weight.
 - b. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.4 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.

D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.

E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum single piece construction with self-adhesive closure. Thickness to match pipe insulation.

F. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

G. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

H. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

I. Adhesives: Compatible with insulation.

2.5 EQUIPMENT INSULATION

A. TYPE E-1: ASTM C553; glass fiber, flexible or semi-rigid, noncombustible.

1. Thermal Conductivity: 0.24 at 75 degrees F.
2. Operating Temperature Range: 0 to 450 degrees F.
3. Density: 1.5 pound per cubic foot.

- B. TYPE E-2: ASTM C612; glass fiber, rigid board, noncombustible with factory applied kraft reinforced aluminum foil jacket.
 - 1. Thermal Conductivity: 0.24 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 450 degrees F.
 - 3. Density: 3.0 pound per cubic foot.
 - 4. Jacket Temperature Limit: minus 20 to 150 degrees F.

- C. TYPE E-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket.
 - 1. Thermal Conductivity: 0.27 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 650 degrees F.
 - 3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
 - 4. Jacket Temperature Limit: minus 20 to 150 degrees F.

- D. TYPE E-4: ASTM C612; semi-rigid, fibrous glass board noncombustible.
 - 1. Thermal Conductivity: 0.27 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 650 degrees F.

- E. TYPE E-5: ASTM C612; glass fiber, semi-rigid board, noncombustible.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Maximum Operating Temperature: 850 degrees F.
 - 3. Density: 3.0 pound per cubic foot.

- F. TYPE E-6: ASTM C553; mineral fiber blanket, Type I.
 - 1. Thermal Conductivity: 0.27 at 75 degrees F.
 - 2. Maximum Operating Temperature: 1000 degrees F.
 - 3. Density: 1.0 pound per cubic foot.

- G. TYPE E-7: ASTM C533; Type II, hydrous calcium silicate block insulation, asbestos free.
 - 1. Thermal Conductivity: 0.45 at 200 degrees F.
 - 2. Operating Temperature Range: 140 to 1200 degrees F.

- H. TYPE E-8: ASTM C534, Type II, flexible, closed cell elastomeric insulation, sheet.
 - 1. Thermal Conductivity: 0.27 at 75 degrees F.
 - 2. Operating Temperature Range: Range: Minus 70 to 220 degrees F.

- I. TYPE E-9: ASTM C612, man made mineral fiber, noncombustible, Classes 1-4.
 - 1. Thermal Conductivity: 0.25 at 100 degrees F.
 - 2. Maximum Service Temperature: 1200 degrees F.
 - 3. Density: 6 pound per cubic foot.

2.6 EQUIPMENT INSULATION JACKETS

- A. PVC Plastic Equipment Jacket:
 - 1. Product Description: ASTM D1785, sheet material, off-white color.
 - 2. Minimum Service Temperature: -40 degrees F.
 - 3. Maximum Service Temperature: 150 degrees F.
 - 4. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.

5. Thickness: 15 mil.
 6. Connections: Brush on welding adhesive.
- B. Aluminum Equipment Jacket:
1. Thickness: 0.020 inch thick sheet.
 2. Finish: Smooth.
 3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch thick aluminum.
- C. Stainless Steel Equipment Jacket:
1. ASTM A240/A240M OR ASTM 666 Type 304 stainless steel.
 2. Thickness: 0.010 inch thick.
 3. Finish: Smooth.
 4. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.
- D. Canvas Equipment Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric with fire retardant lagging adhesive compatible with insulation.
- E. Vapor Retarder Jacket:
1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
 2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
- F. Field Applied Glass Fiber Fabric Jacket System:
1. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
 2. Glass Fiber Fabric:
 - a. Cloth: Untreated; 9 oz/sq yd weight.
 - b. Blanket: 1.0 lb/cu ft density.
 - c. Weave: 10 x 10.
 3. Indoor Vapor Retarder Finish:
 - a. Cloth: Untreated; 9 oz/sq yd weight.
 - b. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.7 EQUIPMENT INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- D. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
- E. Adhesives: Compatible with insulation.

2.8 DUCTWORK INSULATION

- A. TYPE D-1: ASTM C1290, Type III, flexible glass fiber, commercial grade with factory applied reinforced aluminum foil jacket meeting ASTM C1136, Type II.

1. Thermal Conductivity: 0.30 at 75 degrees F.
 2. Maximum Operating Temperature: 250 degrees F.
 3. Density: 0.75 pound per cubic foot.
- B. TYPE D-2: ASTM C612, Type IA or IB, rigid glass fiber, with factory applied all service facing, reinforced aluminum foil facing, metalized polypropylene scrim kraft facing meeting ASTM C1136, Type II.
1. Thermal Conductivity: 0.24 at 75 degrees F.
 2. Density: 1.6 pound per cubic foot.
- C. TYPE D-3: ASTM C612, Type IA or IB, rigid glass fiber, no facing.
1. Thermal Conductivity: 0.24 at 75 degrees F.
 2. Density: 1.6 pound per cubic foot.
- D. TYPE D-4: ASTM C1071, Type I, flexible, glass fiber duct liner with coated air side.
1. Thermal Conductivity: 0.26 at 75 degrees F.
 2. Density: 2.0 pound per cubic foot.
 3. Maximum Operating Temperature: 250 degrees F.
 4. Maximum Air Velocity: 6,000 feet per minute.
- E. TYPE D-5: ASTM C1071, Type II, rigid, glass fiber duct liner with coated air side.
1. Thermal Conductivity: 0.23 at 75 degrees F.
 2. Density: 3.0 pound per cubic foot.
 3. Maximum Operating Temperature: 250 degrees F.
 4. Maximum Air Velocity: 4,000 feet per minute.
- F. TYPE D-6: ASTM C534, Type II, flexible, closed cell elastomeric insulation, sheet.
1. Thermal Conductivity: 0.27 at 75 degrees F.
 2. Service Temperature Range: Range: Minus 58 to 180 degrees F.
- G. TYPE D-7: ASTM C534, Type II, flexible, closed cell elastomeric insulation, sheet laminated with white thermoplastic rubber membrane.
1. Thermal Conductivity: 0.27 at 75 degrees F.
 2. Service Temperature Range: Range: Minus 58 to 180 degrees F.
- H. TYPE D-8: Inorganic blanket encapsulated with scrim reinforced foil meeting UL 1978.
1. Thermal Conductivity: 0.42 at 500 degrees F.
 2. Weight: 1.4 pound per square foot.
 3. Surface Burning Characteristics: Maximum 0/0 flame spread/smoke developed index when tested in accordance with ASTM E84.

2.9 DUCTWORK INSULATION JACKETS

- A. Aluminum Duct Jacket:
1. Thickness: 0.020 inch thick sheet.
 2. Finish: Smooth.
 3. Joining: Longitudinal slip joints and 2 inch laps.
 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

- B. Vapor Retarder Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film 0.0032 inch vinyl.
 - 2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
 - 3. Secure with pressure sensitive tape.
- C. Canvas Duct Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric with fire retardant lagging adhesive compatible with insulation.
- D. Outdoor Duct Jacket: Asphalt impregnated and coated sheet, 50 lb/square.
- E. Membrane Duct Jacket: ASTM D4637; Type I, EPDM; non-reinforced, 0.045 inch thick, 48 inch wide roll; white color.

2.10 DUCTWORK INSULATION ACCESSORIES

- A. Vapor Retarder Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- B. Vapor Retarder Lap Adhesive: Compatible with insulation.
- C. Adhesive: Waterproof type.
- D. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Lagging Adhesive: Fire retardant type with maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- G. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.
- H. Adhesives: Compatible with insulation.
- I. Membrane Adhesives: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify piping, equipment and ductwork has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. Glass Fiber Board Insulation:
 - 1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 - 2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
 - 3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.
- E. Polyisocyanurate Foam Insulation:
 - 1. Wrap elbows and fitting with vapor retarder tape.
 - 2. Seal butt joints with vapor retarder tape.
- F. Hot Piping Systems less than 140 degrees F:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - 3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.
- G. Hot Piping Systems greater than 140 degrees F:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - 3. Insulate flanges and unions at equipment.

- H. Inserts and Shields:
 - 1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
 - 2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
 - 3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.
- I. Insulation Terminating Points:
 - 1. Coil Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the coil control valve.
 - 2. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.
 - 3. Condensate Piping: Insulate entire piping system and components to prevent condensation.
- J. Closed Cell Elastomeric Insulation:
 - 1. Push insulation on to piping.
 - 2. Miter joints at elbows.
 - 3. Seal seams and butt joints with manufacturer's recommended adhesive.
 - 4. When application requires multiple layers, apply with joints staggered.
 - 5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.
- K. High Temperature Pipe Insulation:
 - 1. Install in multiple layers to meet thickness scheduled.
 - 2. Attach each layer with bands. Secure first layer with bands before installing next layer.
 - 3. Stagger joints between layers.
 - 4. Finish with canvas jacket.
- L. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.
- M. Piping Exterior to Building: Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.
- N. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.
- O. Heat Traced Piping Interior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer.

- P. Heat Traced Piping Exterior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water.
- Q. Prepare pipe insulation for finish painting. Refer to Section 09 90 00.

3.3 INSTALLATION - EQUIPMENT

- A. Factory Insulated Equipment: Do not insulate.
- B. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- D. Equipment Containing Fluids Below Ambient Temperature:
 - 1. Insulate entire equipment surfaces.
 - 2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 - 3. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 4. Finish insulation at supports, protrusions, and interruptions.
- E. Equipment Containing Fluids 140 degrees F or Less:
 - 1. Do not insulate flanges and unions, but bevel and seal ends of insulation.
 - 2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
 - 3. Finish insulation at supports, protrusions, and interruptions.
- F. Equipment Containing Fluids Over 140 degrees F:
 - 1. Insulate flanges and unions with removable sections and jackets.
 - 2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
 - 3. Finish insulation at supports, protrusions, and interruptions.
- G. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.
- H. Equipment Located Exterior to Building: Install vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.
- I. Cover cellular glass insulation with metal mesh and finish with heavy coat of insulating cement.
- J. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.

- K. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.
- L. Prepare equipment insulation for finish painting. Refer to Section 09 90 00.

3.4 INSTALLATION - DUCTWORK SYSTEMS

- A. Duct dimensions indicated on Drawings are finished inside dimensions.
- B. Insulated ductwork conveying air below ambient temperature:
 - 1. Provide insulation with vapor retarder jackets.
 - 2. Finish with tape and vapor retarder jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Insulated ductwork conveying air above ambient temperature:
 - 1. Provide with or without standard vapor retarder jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- D. Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with aluminum jacket.
- E. External Glass Fiber Duct Insulation:
 - 1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
 - 2. Secure insulation without vapor retarder with staples, tape, or wires.
 - 3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
 - 4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- F. External Elastomeric Duct Insulation:
 - 1. Adhere to clean oil-free surfaces with full coverage of adhesive.
 - 2. Seal seams and butt joints with manufacturer's recommended adhesive.
 - 3. When application requires multiple layers, apply with joints staggered.
 - 4. Insulate standing metal duct seams with insulation of like material and thickness as adjacent duct surface. Apply adhesive at joints with flat duct surfaces.
 - 5. Lift ductwork off trapeze hangers and insert spacers.
- G. Duct Liner:
 - 1. Adhere insulation with adhesive for 100 percent coverage.
 - 2. Secure insulation with mechanical liner fasteners. Comply with SMACNA Standards for spacing.
 - 3. Seal and smooth joints. Seal and coat transverse joints.
 - 4. Seal liner surface penetrations with adhesive.

5. Cut insulation for tight overlapped corner joints. Support top pieces of liner at edges with side pieces.

H. Ducts Exterior to Building:

1. Install insulation according to external duct insulation paragraph above.
2. Provide external insulation with vapor retarder jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
3. Finish with aluminum duct jacket.
4. Calk seams at flanges and joints. Located major longitudinal seams on bottom side of horizontal duct sections.

- I. Prepare duct insulation for finish painting. Refer to Section 09 90 00.

3.5 SCHEDULES

A. Cooling Services Piping Insulation Schedule:

| PIPING SYSTEM | INSULATION TYPE | PIPE SIZE | INSULATION THICKNESS inches |
|--|-----------------|------------------------------|-----------------------------|
| Chilled Water Supply and Return 40 to 60 degrees F | P-1 | 1-1/4 inches and smaller | 0.5 |
| | | 1-1/2 inches inch and larger | 1.0 |
| Chilled Water Supply and Return less than 40 degrees F | P-1 | 3/4 inch and smaller | 0.5 |
| | | 1 inch to 6 inches | 1.0 |
| | | 8 inches and larger | 1.5 |
| Glycol Supply and Return | P-1 | 1-1/4 inches and smaller | 0.5 |
| | | 1-1/2 inches inch and larger | 1.0 |
| Condensate Piping from Cooling Coils | P-5 | All sizes | 0.5 |
| Refrigerant Suction | P5 | All sizes | 0.5 |
| Refrigerant Hot Gas | P-5 | All sizes | 0.5 |

B. Equipment Insulation Schedule:

| EQUIPMENT | INSULATION TYPE | INSULATION THICKNESS inches |
|---------------------------|-----------------|-----------------------------|
| Generator Exhaust Piping | E-3 | 2.0 |
| Generator Exhaust Muffler | E-7 | 2.0 |

C. Ductwork Insulation Schedule:

| DUCTWORK SYSTEM | INSULATION TYPE | INSULATION THICKNESS inches |
|---|-----------------|-----------------------------|
| Combustion Air | D-2 | 1.5 |
| Outside Air Intake | D-2 | 1.5 |
| Equipment Casings | D-2 | 1.0 |
| Supply Ducts (internally insulated) | D-4 | 1.0 |
| Return Ducts (internally insulated) | D-4 | 0.5 |
| Supply Ducts (externally insulated) Thickness indicated is installed thickness. | D-1 | 1.0 |
| Return Ducts (externally insulated) Thickness indicated is installed thickness. | D-1 | 1.0 |
| Duct Coils | D-1 | 1.0 |
| Kitchen Exhaust Duct (2 layers of 1-1/2 inch each) | D-8 | 3.0 |
| Supply Air, Return Air, Exhaust Air (exterior to building on roof) | D-2 | 2.0 |
| Supply Air, Return Air, Exhaust Air (exterior to building on roof) | D-2 | 2.0 |
| Evaporative Condenser Intake and Exhaust Thickness indicated is installed thickness. | D-1 | 1.0 |
| Exhaust Ducts Within 10 feet of Exterior Openings Thickness indicated is installed thickness. | D-1 | 1.0 |
| Exhaust Ducts Exposed to Outdoor Air | D-2 | 2.0 |
| Rectangular Supply Ducts Downstream of Variable Air Volume Boxes (internally insulated) | D-4 | 0.5 |
| Rectangular Supply Ducts Downstream of Variable Air Volume Boxes (externally insulated) | D-1 | 1.0 |

| | | |
|--|-----|-----|
| Round Supply Ducts Downstream of Variable Air Volume Boxes (externally insulated) | D-1 | 1.0 |
| Transfer Air Ducts (internally insulated) | D-4 | 0.5 |

END OF SECTION 23-07-00

HVAC Piping Insulation

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

SECTION 23 07 19 – HVAC PIPING INSULATION

PART 1 GENERAL

1.1 PROVISIONS

- A. Requirements of Section 01 including, but not limited to, General Requirements, Submittal Procedures, Quality Requirements, Product Requirements, Substitution Procedures, Operation and Maintenance Data, Demonstration and Training shall apply to all work under this section.
- B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition.

1.2 DESCRIPTION

- A. Work covered by this Section includes furnishing of and paying for all materials, labor, services, equipment, licenses, taxes, other items, and appliances necessary for the execution, installation and completion of all work specified herein and/or shown on the drawings.
- B. The work described in this section of the specifications includes but is not limited to the following:
 - 1. Thermal resistance "R" values used herein are expressed in units of "Hour/Degrees F/Sq. Ft./Btu per Inch of Thickness" on a flat surface at a mean temperature of 75 degrees F, unless specifically noted.

1.3 RELATED WORK

- A. The following items of related work are specified and included in other sections of these specifications:
 - 1. Section 22 0500 - Common Work for HVAC, Plumbing, and Fire Protection
 - 2. Section 23 0516 - Piping and Fittings
 - 3. Section 23 3113 - Sheet Metal Ductwork

1.4 APPLICABLE CODES AND STANDARDS

- A. INTERNATIONAL ENERGY CONSERVATION CODE
- B. ASTM E-84.
- C. NFPA 225.
- D. UL 723.
- E. NFPA 90A.

1.5 DEFINITIONS

- A. "Exposed" equipment, ducts and piping are areas which will be visible without removing ceilings or opening access panels. "Concealed" is not "Exposed".

1.6 SUBMITTALS

- A. Submit seven copies of all insulating materials for review by the Engineer.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. CertainTeed, Armstrong, Owens-Corning, Manville.

2.2 CERTIFICATION/QUALITY ASSURANCE

- A. Only products of manufacturers meeting this specification will be approved.
- B. Products shall meet applicable national, model, state and local building codes and be UL (or other recognized testing lab) listed for intended service.
- C. All insulation materials shall be delivered and stored in manufacturer's containers and kept free from dirt, water, chemical, and mechanical damage.
- D. All insulation, adhesives, coatings, sealers, tapes, shall have a flame spread rating of 25 or less and smoke development of 50 or less when tested in accordance with ASTM E-84, NFPA 225, UL 723, and further must meet the requirements of NFPA 90-A where applicable and model and local buildings, plumbing, and mechanical codes.

2.3 MATERIAL FOR PIPE

- A. Materials for Pipe and Equipment: Provide factory pre-molded or shop or site mitered segment type insulation for pipe, pipe fittings, and valves. Fitting insulation shall be of same thickness and material as adjoining pipe insulation.
- B. All miscellaneous tanks, separators, pumps, supports, exchangers, valves, converters, expansion tanks, etc shall be completely insulated with the appropriate material as specified below according to the respective mechanical/plumbing system.

2.4 DUCTWORK

- A. All supply, return and outside air ductwork outside of mechanical rooms shall be externally insulated with 2-1/5 in. thick, 0.75 pounds per cubic foot, blanket flexible mineral fiber insulation conforming to ASTM C 553, Type 1, Class B-3. Provide insulation with factory applied all-purpose jacket with integral vapor barrier. Additionally, the first 15 feet of supply ductwork from each AHU shall be acoustically lined with 1" thick fiberglass duct liner minimum density of 1 ½ pcf. Exhaust duct that is subject to sweating shall also be externally insulated with 2-1/5 in. thick,

0.75 pounds per cubic foot, blanket flexible mineral fiber insulation conforming to ASTM C 553, Type 1, Class B-3. Provide insulation with factory applied all-purpose jacket with integral vapor barrier. All joints and seams shall be sealed with a UL181 metal tape, minimum 3” wide, approved by the insulation manufacturer. Flame spread/smoke developed rating for all insulation shall not exceed 25/50. Acoustically lined ductwork shall also be externally insulated. The R value refers to the installed thickness and NOT out-of-package. Where rectangular ducts are 20” in width (and length) or greater, duct wrap shall be additionally secured to the all sides of the duct with mechanical fasteners such as pins and speed clip washers, spaced on 18” centers maximum to prevent sagging on insulation. Before applying Duct Wrap, ducts shall be clean, dry and tightly sealed at all joints and seams. Seal all tears and punctures and other penetrations of the duct wrap facing. Owens Corning all service fiber glass duct wrap or approved equal.

- B. All supply, return and outside air and exhaust ductwork inside of mechanical rooms shall be externally insulated with 2 in. thick, 6 pounds per cubic foot, rigid board mineral fiber insulation conforming to ASTM C 612, Type IA or Type IB. Provide insulation with factory applied all-purpose foil jacket with integral vapor barrier. Additionally, the first 15 feet of supply ductwork from each AHU shall be acoustically lined with 1” thick fiberglass duct liner minimum density of 1 ½ pcf. Owens Corning Fiberglas 705 Series or approved equal.
- C. Grease Duct (Type 1) and condensate duct (Type 2):
 - 1. Fire-Rated Blanket: 2 layers 1-1/2” thick each High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by UL and acceptable to authority having jurisdiction. Product shall be tested per ASTM E-2336. Provide stainless steel banding and install as per strict manufactures recommendations.
 - 2. Unifrax Corporation; FyreWrap elite 1.5 or approved equal

2.5 AIR DISTRIBUTION DEVICES

- A. Grille, register and diffuser housings and/or plenums, exposed to unconditioned air above ceilings, shall be insulated with 2-1/5 in. thick, 0.75 pounds per cubic foot, blanket flexible mineral fiber insulation conforming to ASTM C 553, Type 1, Class B-3. Provide insulation with factory applied all-purpose jacket with integral vapor barrier. Flame spread/smoke developed rating for all insulation shall not exceed 25/50. The R value refers to the installed thickness and not out-of-package. Before applying insulation, devices shall be clean, dry and tightly sealed at all joints and seams. Seal all tears and punctures and other penetrations of the insulation facing. Owens Corning all service fiber glass wrap or prior approved equal.

2.6 DOMESTIC COLD SUPPLY, HOT SUPPLY AND HOT RETURN WATER PIPING AND EQUIPMENT

- A. Glass Fiber:
 - 1. Provide factory-formed, fiberglass pipe insulated factory-jacketed "system" type similar to Owens-Corning 25 ASJ heavy density, one-piece, dual temperature, pre-molded insulation.
 - 2. Insulate all valves, fittings and flanges with 3-pound density fiberglass insulation to a thickness equal to the adjacent piping insulation and covered with pre-molded 25/50 rated PVC fitting, vapor sealed with Childers CP-30 vapor barrier mastic.
 - 3. Jacket to be fiberglass reinforced kraft paper with aluminum foil.
 - 4. Domestic cold water piping – 1” thick
 - 5. 120°F and 140°F Domestic hot water supply and return – 1” thick

6. Cover all piping, valves, fittings and all miscellaneous devices with .030” thick color coded PVC jacket and pre-molded PVC fittings secured per manufacturer’s recommendations.

2.7 HEATING HOT WATER PIPING AND EQUIPMENT

A. Glass Fiber:

1. Provide factory-formed, fiberglass pipe insulated factory-jacketed "system" type similar to Owens-Corning 25 ASJ heavy density, one-piece, dual temperature, pre-molded insulation.
2. Insulate all valves, fittings and flanges with 3-pound density fiberglass insulation to a thickness equal to the adjacent piping insulation and covered with pre-molded 25/50 rated PVC fitting, vapor sealed with Childers CP-30 vapor barrier mastic.
3. Jacket to be fiberglass reinforced kraft paper with aluminum foil.
4. Insulation thickness, based on insulation having a conductivity range between 0.21 and 0.28 Btu · inch/(h · ft² · °F) and an operating temperature range between 105°F and 140°F, shall be as follows:
 - a. 1.5” thick for pipe sizes 1-1/2" diameter and larger
 - b. 1” thick for pipe sizes 1-1/4” diameter and smaller

- ### B. Cover all piping, valves, fittings and all miscellaneous devices with .030” thick color coded PVC jacket and pre-molded PVC fittings secured per manufacturer’s recommendations.

2.8 CONDENSATE DRAIN

- ### A. Condensate drain piping shall be insulated with flexible cellular insulation, ASTM C 534, Type I, with vapor barrier. Thickness shall be a minimum of ½ inch.

2.9 REFRIGERANT PIPING AND EQUIPMENT

- ### A. Refrigerant piping shall be insulated with flexible cellular insulation, ASTM C 534, Type I, with vapor barrier. Thickness shall be a minimum of 1 inch.
- ### B. All liquid and suction lines shall be insulated continuously from a point 6” inside the air handling unit to the suction service valve at the compressor.
- ### C. Piping design must allow for adequate spacing of insulation thickness and cross ventilation around the insulation. Do not crowd the insulation.

2.10 STORM DRAIN

- ### A. All horizontal storm drain piping up to and including the 5 feet vertical shall be externally insulated with 2 in. thick, 0.75 pounds per cubic foot, blanket flexible mineral fiber insulation conforming to ASTM C 553, Type 1, Class B-3.

2.11 DRAIN PIPING COLLECTING COLD CONDENSATE

- ### A. Condensate drain piping shall be insulated with flexible cellular insulation, ASTM C 534, Type I, with vapor barrier. Thickness shall be a minimum of ½” inch.

2.12 COLOR IDENTIFICATION OF PIPE AND FITTINGS

- A. All insulated pipe shall utilize 0.030” PVC jacket and fittings shall be pre-molded PVC. The PVC shall utilize the color described below for each utility. If the pipe and fittings are not insulated, the utility shall be painted as per the color described below. Sherwin Williams one coat KEM Prime, and 2 coats Sherwin Williams Dura Plate 235 Industrial or prior approved equal.
 - 1. 120 degree domestic hot water – light red
 - 2. 140 degree domestic hot water – purple
 - 3. Domestic cold water – green
 - 4. Natural gas – yellow
 - 5. Fire protection – red

PART 3 EXECUTION

3.1 GENERAL

- A. Insulation shall be applied in a workmanlike manner by experienced, qualified workmen.
- B. Insulation shall not be applied until all pressure testing has been completed, inspected and released for insulation applications. (This does not apply to ductwork acoustical liner.)
- C. No pipe insulation shall be cut where a hanger is located. If hangers have been installed which violates this strict requirement notify the Engineer immediately.
- D. All surfaces shall be clean and dry when covering is applied. Covering to be dry when installed and before and during application of any finish, unless such finish requires specifically a wetted surface for application.
- E. All adhesives, cements, and mastics shall be compatible with materials applied and shall not attack materials in either wet or dry state.
- F. Install insulation using professional insulators who have a minimum of 5 years of experience in commercial or industrial projects.
- G. Exposed-to-view insulation shall have a well tailored appearance.
- H. Install refrigeration piping insulation in accordance with ASTM C1710 and manufacturer installation recommendations.
- I. Insulation end joints to be tightly butted together and the longitudinal seam stapled closed with outward clinch staples, 3" on center. Before stapling, heavily coat the underside of the jacket overlap with vapor barrier adhesive, Childers CP-30 or equal. Locate all longitudinal seams out of sight. Cover end joints with factory furnished, 4" wide vapor barrier striping tapes, heavily coating the underside and secure with vapor barrier adhesive. Seal all ends of pipe insulation with vapor barrier mastic at valves, fittings, flanges, direct hanger contacts and every butt joint of straight run.

- J. Valves, Fittings and Flanges: Insulate all valves, fittings and flanges with 3-pound density, flexible fiberglass insulation to a thickness equal to the adjacent piping insulation and covered with pre-molded 25/50 rated PVC fittings, vapor sealed with Childers CP-30 vapor barrier mastic.
- K. Hangers and Rollers: At hangers and rollers where the pipe is supported by the insulation, the Insulation Contractor shall install an insert section of wood cellular glass or calcium silicate on all piping 3" diameter and larger inside the vapor barrier. The length of insert section shall not be less than 12" for all piping through 8" and 18" on pipe size 10" and over. Coat the insert section with vapor barrier mastic to provide an effective vapor seal. Provide a protective shield covering of 18 gauge for piping 6" and smaller and 16 gauge for 8" and larger, galvanized steel placed centrally between the insert section of all hangers and rollers. Shield shall cover half of the insulation and have a length of not less than 12" on pipe sizes up to 8" and 18" on pipe sizes 10" and over.
- L. Insulate and weather protect all valves and fittings.

END OF SECTION 23-07-19

Building Automation System (BAS) Open System

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

SECTION 23 09 00 – BUILDING AUTOMATION SYSTEM (BAS) OPEN SYSTEM

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Provide all labor, materials, products, equipment and services to supply, install, test and commission Building Automation System (BAS) with Direct Digital Control (DDC) for building mechanical and electrical systems and interface with other microprocessor based building subsystems as indicated on drawings and described herein.
- B. There is no BAS to be extended to the residential suites. The BAS is to control all devices in public areas, common service areas, and retail areas only.
- C. The Base bid is to provide standalone control only, with no central monitoring, trending, scheduling, or Level 1 tier network.
- D. Conform to Section 23 09 23.00 – SEQUENCE OF OPERATION FOR BAS.

1.2 RELATED SECTIONS

- A. Section 21 05 14.00 – WIRING AND STARTERS.
- B. Section 21 05 63.00 – ACCESS DOORS AND ACCESSIBILITY.
- C. Section 21 08 00.00 – COMMISSIONING.
- D. Section 26 05 01.00 – ELECTRICAL GENERAL REQUIREMENTS.

1.3 SYSTEM OUTLINE

- A. General
 - 1. The documentation contained in this section and other contract documents pertaining to Building Automation System (BAS) is schematic in nature. The contractor shall provide all required hardware and software necessary to implement the functions shown or implied in the contract documents.
 - 2. The BAS shall be integrated with other building systems using a common fiber backbone.
- B. Functional Principals
 - 1. BAS to control mechanical and electrical equipment as specified in CONTROL SEQUENCES, SCHEMATICS AND EQUIPMENT SCHEDULES.
 - 2. Each controller to operate independently by performing its own specified control, alarm management, operator I/O and historical data collection receiving information from input field devices and controlling output field devices to perform the control sequences.
 - 3. DDC controller may control more than one system provided that points associated with those systems are connected to that same controller.

4. DDC controllers to be configured so that main inputs and outputs from any control loop are located in that same controller. Global points used for control loop reset such as outdoor air temperature are exempt from this requirement.
5. DDC controllers to be capable of operating with local closed loop programming, independent from the server if communication is interrupted.
6. Where PID control loops are called for in the sequences, they are to be implemented within the controller.

1.4 1.5. QUALITY ASSURANCE

- A. Supplier will have completed [three] [ten] [twenty] million dollars of controls installation work for new construction and retrofit projects with the control system manufacturer over each of the past three years. Submit with the Bid Documents a project list validating the completed work; indicate: project name, city, completed date, controls price, floor area, control system manufacturer.
- B. Supplier will have successfully completed training provided by the control system manufacturer on the manufacturer's product line. Training will have included design, programming and testing of control systems incorporating the manufacturer's product line. Submit with the Bid Documents a copy of the certificate of completed training and indicate the hours of instruction and course outlines.

1.5 CODES AND STANDARDS

- A. Comply with rules and regulations of codes and ordinances of local, provincial, and federal authorities; such codes and ordinances, when more restrictive, take precedence over the Contract Documents.
- B. Provide products listed and classified by the testing firm acceptable to the authority having jurisdiction as suitable for the purpose indicated and specified.

1.6 STANDARD OF EQUIPMENT

- A. Use only new products and software that manufacturer is currently stocking and selling for use in new installations.
- B. Do not use this installation as product test site unless explicitly approved in writing.
- C. Spare parts, software and technical support to be available for at least ten years after acceptance is certified.

1.7 OPEN PROTOCOL STANDARD

- A. Intention of this specification is to provide an integrated, open protocol BAS, either BACnet as defined by ANSI/ASHRAE standard 135 [2012] or LONWorks as defined by ANSI/CEA standard 709.1.
- B. BACnet devices on the lower tier network to support all BACnet functional groups, standard application services and standard object types necessary, but not limited to provide reading and

writing functionality of all analog and binary inputs and outputs and change-of-value initiation and reporting between BACnet devices on the network.

- C. All BACnet devices to be BTL tested. Provide Protocol Implementation Conformance Statement (PICS) for all BACnet devices.
- D. LON devices shall utilize Standard Network Variable Types (SNVTs) as defined by LonMark International and shall have all the functionality for network variable binding.
- E. LON devices shall implement LonMark device profiles as appropriate and be LonMark certified. All devices shall be provided with a LonWorks Network Services (LNS) plug-in configuration utility. If LNS plug-in is not available for a device, all device resource files, XIF files, and points list shall be provided.

1.8 SYSTEM COMMUNICATION ARCHITECTURE

- A. BAS shall use communication architecture consisting of at least two tiers. Each tier will utilize local area networks with totally open protocols based on industry leading standards.
- B. The first tier of the BAS network (level 1) shall be based on Ethernet (ISO 8802-3/IEEE 802-3) communications, providing a high-speed local area network for reliable peer-to-peer communications. Future connected systems shall have compatibility specifications to provide communication with the first tier LAN. The operator workstations shall also be supported on the high speed LAN level 1. Communication speed on first tier network shall be at rate of 10Mbps or higher.
- C. Coordinate with the owner and communication service provider for required number of IP addresses, required number and location of Ethernet ports and subnets; identification of Internet socket port number requirements for external communication through owner firewall.
- D. The lower tiers of the BAS network shall be based on LON or BACnet networks which provide the interconnection of DDC Controllers. Communication speed on lower tier network shall be at rate of 76Kbps or higher. Connection to first tier network shall be provided on every floor of the building.
- E. DDC controllers shall have communication port for temporary connection to laptop computer or operator interface device to allow downloads, uploads and other commissioning and troubleshooting operations.
- F. Plugging a portable operator interface into any DDC controller shall allow access to any other DDC controller on the BAS.

1.9 EQUIPMENT SUPPLIED FOR INSTALLATION UNDER OTHER SECTIONS

- A. Automatic control valves except otherwise noted.
- B. Temperature sensor wells.

- C. Terminal unit controllers including transformers. Ship to terminal unit manufacturer’s facility for factory installation.
- D. Motorized dampers except otherwise noted. Verify damper sizes and connection type with sheet metal contractor prior to ordering.

1.10 BAS PERFORMANCE

- A. Graphic Display: Display the selected graphic representation at Operator Interfaces with current point object data at a minimum rate of twenty points in ten seconds.
- B. Graphic Refresh: Update the selected graphic representation at Operator Interfaces with current point object data at a minimum rate of twenty points in ten seconds.
- C. Data Scan: Update point object data at controllers and Operator Interfaces with current point object data at a minimum rate of once every ten seconds.
- D. Binary Object Command: Controlled device will react within five seconds of an operator initiated command on a binary point object.
- E. Analog Object Command: Controlled device will start to react within five seconds of an operator initiated command on an analog point object.
- F. Alarmed Object Display: Alarm will annunciate visually and audibly at Operator Interfaces within five seconds on local area networks and within forty-five seconds on wide-area networks from the time the object entered the alarmed state.
- G. Program Execution Rate: Provide ability to execute programs at a minimum rate of once every five seconds. Provide execution rates suitable for processes controlled.
- H. PID Execution Rate: Provide adjustable execution rates for proportional-integral-derivative (PID) loops; update the controlled variable and command the controlled device at this same rate. Provide execution rates suitable for processes controlled.
- I. Display and Report Accuracy: Provide minimum accuracy for point object data displayed at Operator Interfaces, reported to printers, reported to data files to Table 1: Display and Report Accuracy.

| Table 1: Display and Report Accuracy. | |
|---------------------------------------|--|
| Point Object | Accuracy |
| Room Air Temperature | [+/-0.36 deg. F] [+/-0.2 deg. C] from actual |
| Duct Air Temperature | [+/-0.36 deg. F] [+/-0.2 deg. C] from actual |
| Outside Air Temperature | [+/-0.36 deg. F] [+/-0.2 deg. C] from actual |
| Dew Point Temperature | [+/-2.7 deg. F] [+/-1.5 deg. C] from actual |
| Water Temperature | [+/-0.36 deg. F] [+/-0.2 deg. C] from actual |
| Relative Humidity | +/-2 % of actual for 20% to 80% RH at [77 |

| | |
|--|---|
| | deg.F] [25 deg. C] |
| Water Flow | +/-1.2 % of actual for 3.0 to 30.0 ft/s |
| Air Flow, Terminal Unit | +/-5.0 % of actual |
| Air Flow, Fan Bell and Duct | +/-5.0 % of actual |
| Air Flow, Pressurized Space | +/-3.0 % of actual |
| Air Pressure, Duct | +/-0.45 % of scale length |
| Air Pressure, Room | +/-0.45 % of scale length |
| Fluid Pressure (other than air) | +/-0.45 % of scale length (see Note 1) |
| Electrical (current, voltage, power) | +/-1.2 % of actual (see Note 2) |
| Carbon Monoxide | +/-3.2 % of actual |
| Carbon Dioxide | +/-3.2 % of actual |
| Note 1: For both absolute and differential pressure. | |
| Note 2: Does not include utility grade meters. | |

- J. Control Tolerance: Maintain controlled variable to control tolerance from set point to Table 2: Control Tolerance.

| Table 2: Control Tolerance | | |
|---------------------------------|---------------------------------------|----------------------------------|
| Controlled Variable | Range | Control Tolerance from Set Point |
| Room Temperature | | [+/-1.1 deg. F] [+/-0.6 deg. C] |
| Duct Temperature | | [+/-1.1 deg. F] [+/-0.6 deg. C] |
| Humidity | | +/-5 % RH |
| Air Flow | | +/-1.0 % of scale length |
| Air Pressure | [0-6 in. w.g.] [0-1500 Pa] | +/-1.0 % of scale length |
| | [-0.1 to 0.1 in. w.g.] [-25 to 25 Pa] | +/- 10.0 % of scale length |
| Fluid Pressure (other than air) | | +/- 1.0 % of scale length |

1.11 SUBMITTALS

- A. Product Data and Shop Drawings:
1. Within 30 days of award of contract, before start of construction, submit completely engineered and coordinated shop drawing package.
 2. To Division 1 – Submittals in printed format and as amended below.
 3. Provide drawing files on CD.

4. Specifications and Instructions: Indicate: dimensions, capacities, electrical characteristics, mechanical characteristics, environmental characteristics, performance characteristics, finishes. Circle model number for products provided or furnished. General catalogue sheets are not acceptable. Provide installation instructions.
5. System Flow Diagrams: Indicate: control devices, control device designation, control device range, control device fail-safe position, point object type, point object name, point object address. Indicate flow directions for gases and liquids relevant to the controlled process. Indicate hardwired interlocks between control devices and equipment. Indicate the location of field control devices.
6. Products Schedule: Indicate: product designation, product name, product manufacturer, product model number, product data sheet reference number, quantities. Provide quantities required under the Work.
7. Valve Schedule: Indicate: system designation, service, medium, quantity, reference drawing, valve type, pipe configuration, fail position, pipe size, valve body size, valve design flow, valve design pressure drop, actual valve pressure drop, design Cv, valve Cv, design close-off, valve close-off, control type, control signal, connection type, valve model number.
8. Damper Schedule: Indicate: system designation, control device designation, duct dimensions, blade width, blade type, damper model number, calculated torque, actuator torque, actuator model number, actuator quantity, actuator fail-safe position, provisions for edge and blade seals, actuator mounting configuration.
9. Room Schedule: Indicate: controller object name, controller address, controller model number, application designation, room designation, VAV air volume set points, sensor model numbers.
10. Cabinet Layouts: Interior: Indicate: orientation of contents including controllers, transformers, cable trays, terminal strips, relays, control devices, labels. Exterior: Indicate: orientation of gauges, displays, switches, labels.
11. Wire Details: Indicate: connections between control devices, controllers and equipment; connections to sources of power and grounds; control device designations, control device terminal designations, control device location; equipment terminal designations; cabinet terminal strip designations; wire designations. For control devices shown on multiple drawings, indicate the control device with the same designation on all drawings. Differentiate between manufacturer installed wire and field installed wire.
12. Sequence of Operation: Provide a complete description of operation to Section 23 09 23.00 – SEQUENCE OF OPERATION FOR BAS. Provide description of operation for interlocks that directly connect to the Work. Indicate references to the system flow diagram by control device designation or point object name.
13. Custom Application Programs (Algorithms): Provide in printed format to Section 23 09 23.00 – SEQUENCE OF OPERATION FOR BAS. Provide comments that describe the details of program functions.
14. Flow Diagrams for Custom Application Programs (Algorithms): Provide in printed format to Section 23 09 23.00 – SEQUENCE OF OPERATION FOR BAS.
15. Points Schedule: Indicate: input points, output points and virtual points for each controller. Indicate: point object address, point object name, point object description, point object alarm limits. List points in ascending order based on point object address.

B. Samples:

1. Provide with submittal under Part 1: Product Data and Shop Drawings for approval by the Owner and/or Consultant:

- a. Test Forms: In printed format for test forms under Part 3: Execution, Testing and Commissioning.
 - b. Products: As specified under Part 3: Execution, Control Devices.
- C. Work Schedule:
1. Provide a schedule of the Work within four weeks of contract award. Indicate: intended sequence of tasks, start dates, task durations, delivery dates for material and equipment requiring long lead times, restraints on work by other trades or situations.
 2. Provide monthly updated Work Schedule indicating percentage complete and revisions to expected delivery dates.
- D. Values Schedule:
1. Provide a schedule of separate system prices that comprises the price of the Work of this Section within four weeks of contract award. In addition to the system price, indicate material and labor prices separately for the system. Indicate each mechanical and electrical system as a separate price. Indicate terminal unit systems of the same type on a floor as a separate system price for the respective floor. Include the price for communication networks and power networks allocated proportionately to the separate system prices. Indicate the Operator Interfaces as a separate system price. Include all costs associated with the work of the system in the separate system price.
 2. The Values Schedule provides the basis for progress payments.
- E. Project Record Documents:
1. Operation and Maintenance Manuals:
 - a. Provide two copies in printed format for review by the Consultant at least ten weeks before the projected substantial completion date.
 - b. Provide three copies of corrected manuals in printed format and three copies on CD within three weeks following completion of Acceptance Test under Part 3: Execution. Provide manuals in hard cover three-ring binders with index page and indexing tab per section.
 - c. Sections:
 - 1) Contact Information: Provide names, addresses, 24-hour telephone numbers of service representatives and installing subcontractors.
 - 2) Operation: Provide owner operating manuals for Operator Interfaces, Controller Resident Software, DDC Controllers, Advanced Application Controllers, Specific Application Controllers, control devices, compressed air system. For Custom Application Programs (Algorithms) Editor, provide a reference manual for the language syntax that describes each function.
 - 3) Engineering, Installation and Maintenance: Provide manuals for design and installation of point objects, controllers, control devices. Provide instructions for calibrating, troubleshooting and replacing controllers and control devices.
 - 4) Preventive Maintenance Procedures: Provide for Operator Interfaces, controllers, control devices. Provide a schedule of tasks; indicate dates for inspection, maintenance and calibration; indicate the pages in the engineering, installation and maintenance manuals that list the procedures.
 - 5) Replacement Parts List: Indicate: manufacturer name, manufacturer model number, supplier name, supplier address, supplier telephone number.
 - 6) Certificates: Provide original issue certificates for installation, maintenance and calibration.

- 7) Test Forms: Provide copies of test forms completed under Part 3: Execution, Testing and Commissioning.
 - 8) Provide certificate of pressure test under Part 3: Execution, Control Air Tubing.
 - 9) Provide licenses, guarantees and warranty documents for products and systems.
2. As-built Product Data and Shop Drawings:
 - a. Provide three copies in printed format and three copies on CD for approval by the Consultant within three weeks following the successful completion of Acceptance Test under Part 3: Execution.
 - b. Provide drawing files on CD.
 - c. Points Schedule: For points schedule generated under Part 1: Submittals, Product Data and Shop Drawings, indicate operating conditions for point object data; list point objects by system designation and alphabetically by point object name.
 - d. Time-of-Day (TOD) Schedules: Indicate: objects assigned to the TOD Schedule, Occupied Mode times.
 3. As-built Floor Plans:
 - a. Maintain on the project site as-built conditions on one full-size set of Contract Drawings, referred to as Marked-up Drawings; indicate on these drawings as-built locations for: control devices, cabinets, network devices with network address, communication networks by type and address, connection points to communication networks for Operator Interfaces, power networks, conduit paths, junction boxes, Operator Interfaces.
 - b. Submit three copies of Marked-up Drawings to Consultant for review within three weeks following successful completion of Acceptance Test under Part 3: Execution. Revise Contract Drawings to match the approved Marked-up Drawings; revise using AUTOCAD Release 12 or higher format and submit three copies as full-size in printed format and three copies of drawing files on CD.
 4. Software Backup:
 - a. Provide with As-built Product Data and Shop Drawings.
 - b. Provide three copies of complete BAS databases on CD.
- F. Training Manuals:
1. Provide a course outline, and one copy in printed format of training manuals provided under Part 3: Execution, Instruction and Training at least six weeks prior to the first class. Modify the course outline and training materials to suit Owner's requirements and as requested by the Consultant.

1.12 WARRANTY

- A. Warrant the Work free from defects for a period of 12 months and in accordance with the General Conditions and as amended below.
- B. Warranty start date will be the date the Work is accepted under Part 3: Execution, Acceptance Test.
- C. Provide a single warranty start date even when the Owner has received beneficial use prior to acceptance of the Work. For Work split into multiple contracts or for a multi-phase contract, provide a separate warranty start date and period for each contract or phase.

- D. Adjust, repair or replace defects and failures in the Work at no additional cost during the warranty period and without reduction in service to the Owner. Provide warranty service during normal business hours and within 24 hours of the Owner’s request for service.
- E. Provide warranty service by factory trained service representatives of the Supplier.
- F. Prior to testing date under Part 3: Execution, Acceptance Test, update firmware in controllers to latest revisions at no additional cost to the Owner; update Operation and Maintenance Manuals with firmware release notes.
- G. During the Warranty period check the tuning of each control loop once during heating season and once during cooling season; notify the Owner when this work is to occur. Forward to the Consultant documentation indicating observations and adjustments made.
- H. Warrant products that are reconditioned under the Work to the same requirements as new products.

1.13 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Software and documentation supplied and generated under the Work or required for ongoing system operation, maintenance and modification becomes the property of the Owner, including and not limited to graphic files, database files, Custom Application Programs, Project Record Documents, Training Manuals.
- B. As of last day of the warranty period, all software to be upgraded to most current recommended version of manufacturer’s release.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Existing Products: To Part 3: Execution, Existing Products.
- B. New Products: Non-beta versions currently under manufacture and have been applied in similar installations for a minimum period of one year.
- C. Revisions: Latest available revision for Operator Software, Controller Resident Software and controller firmware at start of Warranty.
- D. Replacement Parts: Readily available and not scheduled for discontinuation at time of Total Project Completion.
- E. Expansion: Expandable through additional inputs and outputs and to card access, security, fire alarm, lighting control systems and other building systems.

2.2 NETWORK

- A. Provide lower level communication networks supporting all DDC controllers.

- B. A failure of any component or controller on any tier communication network shall not interrupt the execution of communication on these networks.
- C. BAS network shall have an extra 25% capacity for future expansion on all tiers.
- D. Fiber Optic Cable System: Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

2.3 3RD PARTY MANUFACTURER INTERFACE:

- A. 3rd party manufacturer controllers included but not limited to chillers, boilers, variable frequency drives, power monitoring, medical gasses to be based on the open system communication (LON or BACnet) for seamless integration with BAS. Include network connection from BAS to 3rd party manufacturer controllers.
- B. If 3rd party manufacturer controllers are based on different open system standard than BAS, it is the responsibility of BAS contractor to provide the appropriate interface for integration of that 3rd party manufacturer controller to BAS.
- C. If open system controllers are not available, include all appropriate hardware equipment and software to allow bi-directional data communication between the BAS and 3rd party manufacturers' control panels.

2.4 CONTROLLER RESIDENT SOFTWARE

- A. The software resides in Building Controllers and Advanced Application Controllers and is edited by means of the Operator Interface.
- B. Security:
 - 1. Definition: Multiple operators are assigned access levels, and independent user login names and passwords are configurable.
- C. Time-of-Day (TOD) Schedules:
 - 1. Definition: Create, delete and modify TOD Schedules. Assign objects to TOD Schedules based on function and location.
- D. Custom Application Programs (Algorithms):
 - 1. Definition: Create, delete and modify programs and program statements.
 - 2. Syntax Capabilities:
 - a. Analog and binary point objects.
 - b. Conditional statements (IF, THEN, ELSE, ELSE IF) using compound Boolean relations (AND, OR and NOT) and comparisons (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL).
 - c. Floating-point arithmetic using operators for addition, subtraction, division, multiplication and square root; absolute value and minimum/maximum value arithmetic functions.

- d. Predefined objects representing date, time of day, day of week, month of year and elapsed time.
 - e. Create, delete and modify custom function blocks.
- E. PID Control: PID (proportional-integral-derivative), PI and P algorithms for direct acting and reverse acting. Analog output is time-varying. Output control device is adjustable by the operator. Set point and gains are adjustable.
- F. Optimal Start/Stop: Delay equipment start-up to latest possible time which will allow building space to reach target conditions by occupancy time. Advance shut-down of equipment to earliest possible time and maintain space target conditions until the end of occupancy time.
- G. Enthalpy Economizer Control: Control outside, return and exhaust dampers based on inside and outside enthalpy comparisons.
- H. Electrical Demand Management: Manage electrical demand by monitoring power consumption. If consumption exceeds operator adjustable level system to be capable of adjusting set-points, de-energizing low priority equipment and taking other pre-programmed actions as described in SEQUENCES OF OPERATION.
- I. Load Reset: use the zone with the greatest load to reset the set-point of heating or cooling source.
- J. Morning Warm-Up: compare outside and space temperatures and if outside air temperature is less than desired space temperature, run the system before occupancy with fully closed outside dampers until space temperature is satisfied.
- K. Night Cool Down: compare outside and space temperatures and if outside air temperature is less than desired space temperature, run the system during unoccupied hours with outside dampers fully opened until space temperature is satisfied.
- L. Equipment Sequencing: Sequence equipment with lead – leg, duty – standby and priority assignment based upon runtime or operator command as described in SEQUENCES OF OPERATION.
- M. Staged Starts: Operator selectable time delays between starts for equipment on power restoration or scheduled start.
- N. Anti-Short Cycling: Minimum on and minimum off times for equipment.
- O. Dead-band Switch: Cycle a binary point object based on controlled point object and set point for direct acting and reverse acting. Differentials are adjustable.

2.5 DDC CONTROLLERS

A. General

- 1. Input/Output Interface:
 - a. Analog Inputs:
 - 1) Signal: 4 to 20 mA, 0 to 10 VDC, thermistor, RTD.
 - b. Binary Inputs:

- 1) Detect dry contact closure.
 - 2) Wetting Current: Supplied by the controller.
 - c. Pulsed Inputs:
 - 1) Detect pulse of dry contact closure.
 - 2) Pulse Frequency: Compatible with input device.
 - 3) Wetting Current: Supplied by the controller.
 - d. Analog Outputs:
 - 1) Signal: 4 to 20 mA, 0 to 10 VDC. Provide range and zero adjustment.
 - 2) Accuracy Rating: +/- 1% of scale length.
 - e. Binary Outputs:
 - 1) Triac: Rated for 0.5 A at 24 VAC
 - 2) Relay: NO or NC configuration, rated for 3 A at 24 VAC
 - 3) Provide secondary relay for higher loads.
 - f. Minimum Spare I/O Capacity: Controllers to have minimum 20% spare capacity or at least one of each type of I/O available on the controller. This does not apply to Application Specific Controllers.
2. Controllers that perform scheduling operations to have on board real-time clock.
 3. Controllers to continue to provide control functions in event of network communication failure.
 4. Controllers to be swappable without disconnecting the wiring.
 5. Immunity to Power: Rated for 90% to 110% of nominal voltage.
- B. Advanced Application Controllers (AAC):
1. Independent, networked, microprocessor-based.
 2. Reside on lower tier BAS network (BACNet or LON).
 3. Manage connected input and output control devices; transmit real and virtual point object data to distributed controllers and Operator Interfaces.
 4. Continuous monitoring of processor, memory and communication circuits; assume a predetermined failure mode for abnormal conditions; assume a failsafe operating mode for failed communication with objects.
 5. Service communication port for communication with Portable Operator Terminals.
 6. Memory: Nonvolatile EEPROM for firmware. Seventy-two hours of battery backed memory for object database and custom application programs.
 7. Each AAC to support firmware upgrades without need to replace hardware.
 8. Environment: Suitable for anticipated ambient conditions.
 9. Serviceability: LEDs for power, communication and processor status.
- C. Application Specific Controllers (ASC):
1. Microprocessor-based networked. Non-adjustable programs with operator adjustable settings for customized operation within equipment design limits.
 2. Reside on lower tier BAS network (BACNet or LON).
 3. Service communication port for communication with Portable Operator Terminals.
 4. Memory: Nonvolatile EEPROM memory for firmware and program data.
 5. Environment: Suitable for anticipated ambient conditions.
 6. Serviceability: LEDs for power, communication and processor status.

2.6 POWER SUPPLIES AND LINE FILTERING

- A. Provide a separate power supply for every Building Controller, Advanced Application Controller and Application Specific Controller for terminal units.
- B. Power Supplies:
 - 1. Type: Enclosed; Class 2 current-limiting, or over-current protection in primary and secondary circuits for Class 2 service to the National Electrical Code.
 - 2. Applied Loads: To 80% of rated capacity.
- C. DC Power Supplies: Regulated output.
 - 1. Built in over voltage and over current protection.
 - 2. Able to withstand 150% current overload for at least 3 seconds without trip or failure.
- D. Power Line Filtering: Provide internal or external transient voltage and surge suppression for workstations and controllers.

2.7 CABINETS

- A. Type: NEMA rated and suitable for installed environment.
- B. Door: Hinged with key-lock latch with common key for all cabinets; provide duplicate keys; for Application Specific Controllers provide screwed tight slide-off cover.
- C. Controllers, transducers and relays mounted on backing board or DIN rails within inner section behind hinged doors.

2.8 CONTROL DEVICES

- A. Motorized Control Dampers:
 - 1. Sizing:
 - a. Dimensions: As indicated. Maximum damper section size: [48 in. x 60 in.] [1200 mm x 1500 mm]. For dampers larger than the section maximum, use an assembly of multiple, equally sized sections.
 - b. Two-position: Parallel blade.
 - c. Modulating: Opposed blade. Parallel blade dampers may be used for return air and bypass applications.
 - 2. Frame: [5 in. x 1 in. x 0.125 in.] [125 mm x 25 mm x 3 mm] 6063T5 extruded aluminum with mounting flanges on both sides.
 - 3. Blades: Airfoil shape, 6063T5 extruded aluminum, maximum [6 in.] [150 mm] depth.
 - 4. Seals:
 - a. Blade Edge: Extruded thermoplastic rubber (TPR) suitable for [-72 deg. F to 275 deg. F] [-58 deg. C to 135 deg. C], mechanically locked in place and easily replaceable in the field.
 - b. Blade Jamb: Spring-loaded stainless steel.
 - 5. Bearings: Molded synthetic.
 - 6. Linkage: Corrosion resistant steel and concealed in the frame.
 - 7. Drive Shaft: Corrosion resistant steel of square or hexagon shape.
 - 8. Axle: Corrosion resistant steel.

9. Leakage: Maximum [8 CFM/sq ft] [0.35 L/s/sq m] at [4 in. w.g.] [1.0 kPa] of differential pressure across fully closed damper when tested to AMCA Standard 511.
10. Make and Model: Ruskin CD-50 or equivalent.

B. Actuators For Dampers, Electronic:

1. Control Signal: Compatible with BC, AAC and ASC.
2. Floating control signal is acceptable only for VAV damper application.
3. Operating Time: Maximum 120 seconds throughout the full rotation.
4. Angle of Rotation: Adjustable between 0° to 90°.
5. Stall protection: Mechanical or electronic.
6. Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire rotation.
7. Failsafe: Non-spring return for VAV terminals; spring return for other applications. Spring return to normal position within 15 seconds.
8. Manual Override: Crank type. External gear release for non-spring return actuators.
9. Position Indicator: Reversible for clockwise or counter-clockwise rotation; set the 0 degrees mark to the failsafe position.
10. Torque: To damper manufacturer's requirements to provide complete compression of seals between frame and blades and for smooth control.
11. Provide UL555S listed damper actuators for all dampers used in smoke control.

C. Control Valves:

1. Characteristics, materials and pressure ratings suitable for the application; refer to schedules.
2. Flow Characteristic:
 - a. Water:
 - 1) Two-way: Equal percentage.
3. Sizing Water Valves:
 - a. Two-position: Line size with full ports.
 - b. Two-way Modulating: Non Radiation: Pressure drop equal to the pressure drop through the coil or [4 psi] [27 kPa], whichever is greater. Radiation: Pressure drop equal to [1 psi] [7 kPa].
 - c. Three-way Modulating: Non Radiation: Pressure drop equal to the pressure drop through the coil or [4 psi] [27 kPa], whichever is greater. Radiation: Pressure drop equal to [1 psi] [7 kPa].
 - d. Butterfly Valves:
 - 1) Type: High-performance (HPBV).
 - 2) Make and Model: Dezurik BHP or equivalent.
 - 3) Tee-fitting: Provide for three-way application; with motor mounting bracket and linkage hardware.
 - e. Valves [1/2 in.] [12 mm] through [2 in.] [50 mm]:
 - 1) Screwed ANSI Class 250 bronze body.
 - f. Valves [2-1/2 in.] [62 mm] and Larger:
 - 1) Water temperature less than [250 deg. F] [121 deg. C] at [150 psi] [1035 kPa] or less than [200 deg. F] [93.2 deg. C] at [165 psi] [1139 kPa]: Flanged ANSI Class 125 cast iron body.
 - 2) Water temperature greater than [250 deg. F] [121 deg. C] at [150 psi] [1035 kPa] or greater than [200 deg. F] [93.9 deg. C] at [165 psi] [1138 kPa]: Flanged ANSI Class 250 cast iron body or ANSI Class 300 cast steel body.
4. Leakage: ANSI Class IV.

5. Materials:
 - a. Stems: Stainless steel.
 6. Rangeability: 40:1 minimum.
- D. Pressure Independent Control Valves:
1. Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of the piping system, unless otherwise indicated.
 2. Calibrated Balancing Valves and Automatic Flow-Control Valves shall not be required on devices where pressure independent control valves are installed.
 3. The control valves shall accurately control the flow from 0 to 100% full rated flow with an equal percentage flow characteristic.
 4. Each control valve shall be individually flow tested and factory verified to deviate no more than $\pm 5\%$ through the operating pressure range. A calibrated performance tag shall be provided with each valve (optional for [1/2"] [15mm]) listing the measured flow rate in 10° rotation increments.
 5. Valve bodies [2"] [50mm] and smaller shall be brass. Valve bodies [3"] [80mm] thru 8" [200mm] shall be ductile iron. All internal parts shall be brass, carbon steel, stainless steel or Teflon®. Plastic internal parts are not acceptable
 6. Control valve rangeability shall be 100:1 minimum.
 7. The manufacturer shall warrant all components for a period of 5 years from the date of production.
 8. The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory, or shall be provided with universal mounting plate to allow installation of actuators meeting system electrical and valve torque requirements.
- E. Actuators for Control Valves, Electronic:
1. Control Signal: Compatible with BC, AAC and ASC.
 2. Floating control signal is not acceptable.
 3. Operating Time: Maximum 120 seconds throughout the full rotation.
 4. Mounting: Corrosion resistant hardware.
 5. Stall Protection: Electronic overload or digital rotation sensing.
 6. Failsafe: Non-spring return for radiation and terminal reheat coils; spring return for others. Spring returns to normal position within 15 seconds.
 7. Manual Override: Crank type. External gear release for non-spring return actuators.
 8. Position Indicator: Provide. Indicate valve open and closed positions.
 9. Close-off Pressure:
 - a. Water:
 - 1) Two-way: 150% of total system head.
 - 2) Three-way: 300% of the pressure differential between ports A and B at design
- F. Electric Relays:
1. Type: General purpose; enclosed coil; diodes provided for inductive switched loads; override button; LED "energized" indicator; plug-in type base.
 2. Contact rating, configuration and coil voltage suitable for application.
 3. Regulatory: UL listed.
- G. Damper End Switches:
1. Type: Lever operated activated by blade position.
 2. Electrical Contacts: Rated for 10 A resistive, 6 FLA at 120 VAC.

3. Regulatory: UL listed.
- H. Level Switches:
1. Type: Float.
 2. Electrical Contacts: Rated for 10 A resistive, 6 FLA at 120 VAC.
 3. Mounting: Outside of measured fluid.
 4. Enclosure: NEMA rated for the application.
- I. Ultrasonic Level Transmitter:
1. Service: Compatible fluids. Not for use with powder and bulk solids.
 2. Accuracy: $\pm 0.2\%$ of maximum range.
 3. Resolution: [0.079"] [2 mm].
 4. Output Signal: 4 to 20 mA (Two-wire).
 5. Temperature Compensation: Automatic.
 6. Enclosure Rating: NEMA rated for the application.
 7. Failsafe: On lost echo after 30 seconds, user selectable to 4, 20, 21, 22 mA or last signal.
 8. Display: 6 character LCD.
 9. Agency Approvals: CE compliance, FM approved.
- J. Low Limit Electromechanical Thermostat:
1. Type: Vapour Pressure; minimum [20 ft.] [6000 mm] of capillary; actuated by any [12 in.] [300 mm] of capillary element; manual reset upon activation.
 2. Electrical Contacts: Double-pole double-throw (DPDT), snap-acting; rated for 10 A resistive, 6 FLA at 120 VAC.
 3. Adjustable Set Point: Range: [30 deg. F to 55 deg. F] [-1 deg. C to 13 deg. C] and set to [35 deg. F] [1.67 deg. C].
 4. Regulatory: UL listed.
- K. High Limit Electromechanical Thermostat:
1. Type: Bimetallic sensing; manual reset upon activation.
 2. Mounting: Air stream.
 3. Electrical Contacts: Single-pole single-throw (SPST), normally closed, snap-acting; rated for 10 A resistive, 6 FLA at 120 VAC.
 4. Adjustable Set Point: Range: [100 deg. F to 150 deg. F] [38 deg. C to 66 deg. C] and set to [135 deg. F] [57 deg. C].
- L. Electromechanical Thermostat:
1. Wall Mount:
 - a. Provide samples of covers to Part 1: Submittals, Samples.
 - b. Low Voltage:
 - 1) Type: 24 VAC, bimetal-operated, mercury-switch; adjustable or fixed anticipation heater; vented ABS plastic concealed cover.
 - 2) Set Point: Range: [55 deg. F to 85 deg. F] [13 deg. C to 30 deg. C]; [2 deg. F] [1 deg. C] maximum differential.
 - c. Line Voltage:
 - 1) Type: Bimetal-actuated open contact, or bellow-actuated enclosed snap-switch type, or equivalent solid state type; anticipation heater; vented metal concealed cover.
 - 2) Electrical Contacts: Rated for 10 A resistive, 6 A FLA at 120 VAC.

- 3) Set Point: Range: [55 deg. F to 85 deg. F] [13 deg. C to 30 deg. C]; [2 deg. F] [1 deg. C] maximum differential.
- 4) Regulatory: UL listed.

M. Digital Thermostat:

1. Digital thermostats shall be 7-day programmable digital type suited for the application.
2. Standalone terminal units shall utilize a digital thermostat where shown on drawings.
3. Digital thermostat shall have user selectable engineering units (F or C) and set point adjustment.
4. Digital thermostat shall support automatic daylight savings time switchover.
5. Digital thermostat shall support automatic and manual heat/cool changeover when applicable.
6. Digital thermostat shall support temporary set point adjustment with automatic return to normal operation.

N. Temperature Sensors:

1. General Requirements:
 - a. Temperature sensors shall be of the resistance type, two-wire 1000 ohm nickel RTD, two-wire 1000 ohm platinum RTD or two-wire 10,000 ohm thermistor.
2. Space Temperature Sensors:
 - a. For installation throughout the facility unless otherwise noted.
3. Space Temperature Sensors with Adjustable Set-Point, Override and Display:
 - a. Key pad or slider for temperature set-point adjustment.
 - b. LED display.
 - c. Timed override request push button with LED status for activation of after-hours operation.
 - d. For installation only where indicated on drawings, controls diagrams or sequences of operations.
4. Covers for Wall Mount Sensors:
 - a. Overrides: Exposed set point adjustment and override button.
 - b. Communication Port: For communication between Portable Operator Terminals and ASC controllers.

Averaging Temperature Sensors:

 - c. Minimum [5 ft] [1.5 m] of capillary per [10 sq ft] [1 sq m] of duct cross-section.
 - d. Provide multiple sensors where single averaging element is unable to be positioned to provide complete duct or plenum traverse.
5. Outside Air Temperature Sensors:
 - a. Outside air temperature sensors shall be designed to withstand the environmental conditions to which they will be exposed.
 - b. The sensors shall be provided with a solar shield.
 - c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
6. Duct Temperature Sensors:
 - a. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
 - b. Probe length shall be no less than 1/3 of the duct width or diameter.
 - c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
7. Thermowells:

- a. Brass or Type 316 stainless steel suitable for the application.
 - b. Heat transfer compound compatible with sensing element.
- O. Guards for Sensors and Thermostats:
- 1. Materials: Heavy gauge steel.
- P. Relative Humidity Sensors:
- 1. Sensors shall be calibrated to NIST standards.
 - 2. Sensing Element:
 - a. Type: Thin film capacitance.
 - 3. Transmitter:
 - a. Range: 0 to 100% RH.
 - b. Signal: 4 to 20 mA or 0-10 VDC with span and zero adjustment.
 - 4. Accuracy Rating: +/- 2 % of output reading.
 - 5. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure.
 - 6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
- Q. Pressure Sensors:
- 1. General:
 - a. Sensing Element:
 - 1) Type: Capacitance sensing.
 - 2) Materials: Suitable for continuous contact with measured medium.
 - b. Transmitter:
 - 1) Range: Not to exceed two times the operating pressure.
 - 2) Signal: 4 to 20 mA or 0-10 VDC; with zero and span adjustment.
 - 3) Accuracy Rating: +/- 1.0 % of full scale.
 - 4) Response Time: Maximum 0.5 seconds.
 - c. Isolation Valve: Between process connection and sensor.
 - d. Capable of withstanding 100% overpressure without damage
 - 2. Air Static Pressure Sensors:
 - a. Sensing Element:
 - 1) Type: Capacitance sensing with pitot tube sensing tips screwed securely to duct.
- R. Submersible Pressure Sensor:
- 1. The sensor housing shall be made from high strength stainless steel or titanium for pressure ranges up to [100 PSI] [689.5 kPa] and compatible with wide range of liquids.
 - 2. The sensor shall be vented through the cable to correct for barometric pressure changes.
 - 3. Sensor over range protection shall be two times rated pressure.
 - 4. Accuracy shall be +/- 0.25% of the full scale or better.
 - 5. Available control signals shall be 2-10 VDC or 4-20 mA.
- S. AC Current Sensing Switches:
- 1. Type: Self-powered solid-state with split-core.
 - 2. Electrical Contacts: Rated for 1 A resistive at 30 VAC/DC.
 - 3. Insulation Rating: 600 VAC.
 - 4. Adjustable trip point with LED status indicator.

T. AC Current Transducers:

1. Type: Self-powered or loop-powered solid-state with split-core.
2. Amperage Range: Motors: Factory calibrated to LRA; Switchgears: Factory calibrated to design load.
3. Insulation Rating: 600 VAC.
4. Signal: 4 to 20 mA or 0-10 VDC; internal zero and span adjustment.
5. Accuracy Rating: +/- 2 % of full scale.
6. Regulatory: UL listed.

U. CO2 Sensors:

1. Sensor shall employ non-dispersive infrared technology (NDIR).
2. Accuracy shall be +/- 75 ppm over 0-1500 ppm range.
3. Response time shall be less than 1 minute.
4. Sensor shall have field selectable 0-10 VDC and 4-20 mA outputs.
5. Power voltage shall be 20-30 VDC/AC.
6. Operating temperature range shall be 0°C to 50°C.
7. The sensor shall be wall/duct mount.

V. Gas Detection System:

1. Gas Detection Controller:

- a. Use: Centralized gas detection monitoring with real-time gas reading, selective alarm activation
- b. Enclosure: NEMA 4X Polycarbonate – ABS
- c. Power Requirement: 17-27 Vac, 24-38 Vdc, 500 mA
- d. Network: Three Modbus channels for up to 96 transmitters and an optional BACnet/LON/IP output; Communication Line Up to [2000 ft.] [609 m] per channel
- e. Alarm Levels: fully programmable alarm levels; Time Delays 0, 30 sec., 45 sec., 1-99 minutes before and after alarm
- f. Outputs: 4 DPDT relays (alarms and/or fault) at 5 A, 30 Vdc or 250 Vac (resistive load); 65dBA buzzer
- g. Display: 122 x 32 dot matrix LCD display
- h. Operating Humidity Range: 0-95% RH, non-condensing
- i. Operating Temperature Range: [-4 to 122°F] [-20 to 50°C]
- j. Certifications: <<<INSERT APPLICABLE CERTIFICATIONS>>>
- k. Conforms to: ANSI/UL 61010-1; IEC 61010-1 Including Amendments A1:1992 + A2:1995 and National Deviations (US)
- l. Make and Model: Honeywell 301C or equivalent.

2. Wired or Stand-Alone Gas Transmitter:

- a. Use: Wall mounted, wired gas detector transmitter used in conjunction with controller
- b. Power Requirement: 24 Vac nominal (17-27), 50/60 Hz, 0.35A; 24 Vdc nominal (20-38Vdc)
- c. Network: Modbus RS-485; BACnet MS/TP master
- d. Display: 8 character, 2 line backlit LCD
- e. Visual Indicators: Green LED; Power, Amber LED 1: Alarm/ Fault, Amber LED 2: Alarm/ Fault
- f. Audible Alarm: >85 dbA at 3m (10ft)
- g. Relay Output: Network 1 DPDT relay, 5A @ 250Vac; 5A @ 30 Vdc; Stand Alone 2x DPDT relay, 5A @ 250Vac; 5A @ 30 Vdc

- h. Sensing Technology: Toxic = Electrochemical; Combustibles = Catalytic; Oxygen = Diffusion fuel cell
 - i. Accuracy: Toxic, Combustibles, Oxygen = +/- 3%
 - j. Detection Range: Carbon Monoxide = 0 - 250 ppm; Nitrogen Dioxide (NO₂) = 0-10 ppm; Oxygen = 0-1 ppm; Combustibles = 0-100% LEL;
 - k. Certified to: <<<INSERT APPLICABLE CERTIFICATIONS>>>
 - l. Conforms to: ANSI/UL 61010-1
 - m. Make and Model: Honeywell E3 Point sensors or equivalent.
- W. Chiller Mechanical Room Refrigerant Gas Detection System:
- 1. Gas Detection Controller /Expansion Module - Inside Chiller Mechanical Room
 - a. Use: Centralized Stand Alone refrigerant gas detection monitoring main controller with real-time gas reading, selective alarm activation
 - b. Power Requirement: 22-27 Vac, 29-38 Vdc, 2A max @ 29Vdc
 - c. Up to 20 gas transmitters, Digital Communication Modbus RS-485 Line, Up to [200 ft.] [61 m] from the controller.
 - d. Alarm Levels: 3 fully programmable alarm levels
 - e. Outputs: 4 DPDT form C relays (alarms and/or fault) at 5 A, 30 Vdc or 250 Vac (resistive load); 65dBA buzzer, 3 Outputs at 24 Vdc @ 250 mA each
 - f. Integral Strobe/Horn: STAS flashing LED/105dBA, 4-28V, 2800Hz (RFSA)
 - g. Display: 122 x 32 dot matrix backlit LCD display
 - h. Visual Indicators: - Green LED – Normal Operation
 - i. Red LED Gas Alarm A, B, and C
 - j. Yellow LED: Fault/Service
 - k. The Controller/expansion module must provide all the functionalities necessary to comply with current ASHRAE 15 guidelines.
 - l. Manual Fan Start/Stop operation
 - m. Audible Alarm with a silence key to acknowledge
 - n. Visible Alarm
 - o. Operating Humidity Range: 0-95% RH, non-condensing
 - p. Operating Temperature Range: [32°F to 100°F] [0°C to 40°C]
 - q. Enclosure rating: NEMA 4X, ABS - Polycarbonate - indoor
 - r. Conforms to: ANSI/UL 61010-1; IEC 61010-1 Including Amendments A1:1992 + A2:1995 and National Deviations (US)
 - s. Make and Model: Honeywell 301EM RFSA or equivalent
 - 2. Gas Detection Remote Annunciator Panel: Outside Chiller Mechanical Room
 - a. Use: Remote Annunciator / Slave display panel located outside each entrance to Chiller Mechanical room
 - b. Power Requirement: 22-27 Vac, 50 or 60 Hz, 29-38Vdc, 2.0 A max @ 24 Vdc
 - c. Up to 10 remote Annunciator panels can be connected to the main refrigerant gas detection Controller; Digital Communication Modbus RS-485 up to [1000ft] [304m]
 - d. The remote annunciator panel must provide all the functionalities necessary to comply with Current ASHRAE 15. This includes a key for manual “fan start” only operation, strobe/horn audible visual alarm on top of the unit
 - e. Display 122 x 32 dot matrix backlit LCD display
 - f. Visual Indicators: - Green LED – Normal Operation
 - g. Red LED Gas Alarm A, B, and C
 - h. Yellow LED: Fault/Service

- i. The Remote annunciator panel will indicate the exact concentration of refrigerant gas as displayed on the 301EMRFSA Main Controller and the refrigerant gas detected. The LCD display screen will indicate multiple alarm levels for each sensing point
 - j. Operating Temperature Range: [32°F to 100°F] [0°C to 40°C]
 - k. Enclosure rating: NEMA 4X, ABS - Polycarbonate - indoor
 - l. Conforms to: ANSI/UL 61010-1; IEC 61010-1 Including Amendments A1:1992 + A2:1995 and National Deviations (US)
 - m. Make and Model: Honeywell 301EM RP RFSA or equivalent
 3. Wired Refrigerant Gas Transmitter:
 - a. Use: Wall mounted, wired refrigerant gas detector transmitter used in conjunction with 301EMRFSA controller, Diffusion Type with no internal sample pump or filter maintenance required
 - b. Power Requirement: 8.5 - 12.5 Vdc, 1A@10 Vdc Maximum
 - c. Network: Modbus RS-485
 - d. Sensing Technology: NDIR (Non Dispersive Infrared)
 - e. Accuracy: ± 10 ppm @ 50 ppm / ± 40 ppm @ 500 ppm
 - f. Detection Range: Refrigerants 0-1000 ppm
 - g. R11, R12, R13B1, R22, R114, R123, R125, R134a, R227, R245A, R404A, R407C, R410A, R507, R508b
 - h. Resolution: 1 ppm
 - i. Response Time (T90) 60 seconds
 - j. Operating Temperature Range: [32°F to 100°F] [0°C to 40°C]
 - k. 0 to 95% RH (non-condensing)
 - l. Enclosure NEMA 4X ABS/Polycarbonate - Indoor
 - m. Conforms to: ANSI/UL 61010-1
 - n. Make and Model: Honeywell 301IRFS sensors or equivalent.
- X. Water Flow Meters:
 1. Provide an Electromagnetic Flow Meter complete with integral or remote transmitter.
 2. The transmitter shall include a backlit graphic display and keypad. Output signals shall be 4-20 mA and programmable pulse.
 3. The flow meter shall be installed either in the supply or return pipe of the system to be measured following the manufacturer's instructions. The flow meter size shall be selected based on the minimum and maximum flow range for the application.
 4. Connections to the piping shall be ANSI class 150 flanges (ANSI class 300 where required).
 5. The flow tube shall be epoxy coated steel; the sensing electrodes shall be 316SS; the liner shall be polypropylene or ebonite for low temperature service, PTFE for hot water service (302 F maximum).
 6. Each flow meter shall be individually wet-calibrated and accurate to within $\pm 0.2\%$ of reading from 3 to 33 feet per second velocity. A certificate of calibration shall be provided with each flow meter.
 7. The flow meter shall be capable of measuring bi-directional flow.
 8. For installations in non-metallic pipe, an internal grounding electrode shall be provided which eliminates the need for external grounding rings.
 9. Each flow meter shall be factory programmed for its specific application, and shall be re-programmable using the integral keypad on the converter (no special interface device or computer required).
 10. Make and Model: ONICON F-3000 Series Electromagnetic Flow Meter or equivalent.

Y. Gas Meters:

1. Provide a Diaphragm Gas Meter complete with integral or remote transmitter.
2. Transmitter output signal shall be a programmable pulse.
3. Meter shall be temperature compensated for better accuracy.
4. Meter shall meet ANSI B109.2 specification.
5. Meter shall be Measurement Canada accredited.
6. Make and Model: Elster American Meter AL-800 or equivalent.

Z. BTU Meters:

1. The entire Btu metering system shall be built and calibrated by a single manufacturer and shall consist of a flow meter, two temperature sensors, a Btu meter, temperature thermo wells, and all required mechanical installation hardware. A certificate of NIST (U.S. National Institute of Standards and Technology) traceable calibration shall be provided with each system. All equipment shall be covered by the manufacturer's two year warranty.
2. The Btu meter shall provide the following information via both an integral LCD, and via network communications (protocol conforming to BACnet or LON): Energy Total, Energy Rate, Flow Total, Flow Rate, Supply Temperature and Return Temperature. Each Btu meter shall be factory programmed for its specific application, and shall be re-programmable using the front panel keypad (no special interface device or computer required).
3. Insertion type flow meters shall be provided complete with all installation hardware necessary to enable insertion and removal of the meter without system shutdown, and be hand-insertable up to 400 psi. Inline meters shall be installed with isolation valves to allow installation or removal of the flow meter without a system shutdown. Turbine rotation shall be detected by electronic impedance-based sensing (non-magnetic). Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST. A certificate of calibration shall be provided with each flow meter. Accuracy shall be within $\pm 0.5\%$ of rate at the calibrated velocity, within $\pm 1\%$ of rate over a 10:1 turndown (3.0 to 30 ft/s) and within $\pm 2\%$ of rate over a 50:1 turndown (from 0.4 to 20 ft/s). The flow meter shall include an integral 0-15V square wave output as an input to the Btu Meter.
4. Temperature sensors shall be loop-powered current based (mA) sensors and shall be bath-calibrated and matched (NIST traceable) for the specific temperature range for each application. The calculated differential temperature used in the energy calculation shall be accurate to within $\pm 0.150\text{F}$ (including the error from individual temperature sensors, sensor matching, input offsets, and calculations).
5. Make and Model: ONICON System-10 BTU Meter or equivalent.

AA. Energy Meters:

1. The energy meter shall conform to ANSI C12.1 metering accuracy standards.
2. The energy meter shall consist of a meter and CTs calibrated together as a system.
3. Accuracy shall be $\pm 1\%$ from 2-100 % of rated current.
4. The energy meter shall not require annual recalibration.
5. The energy meter shall derive operating power from its metering connection and shall not require separate control power connection.
6. The energy meter electronics shall automatically correct for CT phase reversal.
7. LCD display shall show accumulated kWh, Amps, Voltage.
8. The energy meter shall have a pulse output with selectable pulse output rates.
9. The energy meter shall meet UL and cUL specifications.

BB. Air Flow Stations (Fan Bell Mouth):

1. The measuring device shall consist of air flow traverse probes mounted on the fan bell mouth. The probes shall contain multiple total and static pressure sensors placed at concentric area centers along the exterior surface of the cylindrical probe and internally connected to their respective averaging manifolds. Sensors shall not protrude beyond the surface of the probe, not be adversely affected by particle contamination normally present in building system airflows. The fan inlet air flow traverse probes (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 and shall be of aluminum construction with hard anodized finish. The fan inlet airflow traverse probes shall not induce a measurable pressure drop, nor shall the sound level with the system be amplified by its presence in the fan inlet bell. The probes shall be capable of producing steady, non-pulsating signals of total and static pressure, without need for flow corrections or factors, with an accuracy of +/- 3% of actual flow over a fan operating range of 6 to 1 capacity turndown.
2. Velocity pressure transmitter shall be selected to suit the system working pressures and shall meet the following performance requirements:
 - a. Calibrated accuracy within +/- 0.25% of span.
 - b. Repeatability within 0.05% of output.
 - c. Dead bank & hysteresis not detectable or measurable.
3. Square root extractor and multiplier shall meet the following performance requirements:
 - a. Calibrated Accuracy: +/- 0.5% of flow.
 - b. Hysteresis: Not detectable.
 - c. Repeatability: 0.05% of output.
 - d. Response: 0.5 seconds.
 - e. Multiplier: Adjustable 0.3 to 2.8.
4. Provide a control panel that shall contain all control equipment. Each panel shall have a hinged door, latch and lock.
5. Transmitter shall provide a 4 to 20 mA or 0 to 10 VDC signal proportional to flow to the BAS. The signal shall be converted to L/S (CFM) by the BAS.
6. The fan inlet airflow traverse probes and velocity pressure transmitter shall be Air Monitor Corporation VOLU-probe/FI and Veltron II.
7. Acceptable equal shall be Ebtron Gold Series:
 - a. The air sensors shall be self heated thermistors and epoxy encapsulated temperature sensors. The heated element shall determine velocity and the other shall provide a reference temperature signal to the velocity sensor to compensate for temperature changes in the air flow. There shall be a minimum of two sensors per type, per inlet.
 - b. Individual flow sensors shall transmit digital flow/temperature information to a microprocessor based control panel which shall total/average signals and output flow signals (CFM or L/S) to the host DDC panel. The signals shall be linear 0 to 10 VDC or 4 to 20 mA.
 - c. The velocity linearity shall be 2% of reading, with a repeatability of 3% scale, over a fan operating range of 6 to 1 capacity turndown. The station shall not induce a measurable pressure drop or increase the sound emitted by the system.
 - d. A control panel shall be provided with an alpha numeric display of the air volumes and temperature of the points monitored. A keypad or PC link shall allow remote monitoring, trouble shooting or system reconfiguration.

CC. Air Flow Stations (Duct Mount):

1. Fan air volume measuring device shall be either rectangular or round as indicated. Unit shall have 14 gauge galvanized sheet steel casing, flanged for installation to duct or plenum as applicable, with aluminum honeycomb equalizer and air straightening grid with copper static pressure sensors and total pressure sensors, installed in a grid pattern to provide total coverage of the device. Unit shall be capable of reading volumes within 1% for a velocity range of 800 to 4000 feet per minute (4 to 20 m/s).
2. Velocity pressure transmitter shall be selected to suit the system working pressures and shall meet the following performance requirements:
 - a. Calibrated Accuracy: +/- 0.25% of span.
 - b. Repeatability: 0.05% of output.
 - c. Dead bank & hysteresis: Not detectable.
3. Square root extractor and multiplier shall meet the following performance requirements:
 - a. Calibrated Accuracy: +/- 0.5% of flow.
 - b. Hysteresis: Not detectable.
 - c. Repeatability: 0.05% of output.
 - d. Response: 0.5 seconds.
 - e. Multiplier: Adjustable 0.3 to 2.8.
4. Control panel shall be industrial standard wall mounted and shall contain all control equipment. Each panel shall have a hinged door, latch and lock.
5. Flow measuring device and velocity pressure transmitter shall be Air Monitor Corporation Fan-Evaluator and Veltron II.
6. Acceptable equal shall be Ebtron Gold Series:
 - a. Each thermal flow sensor shall contain two individual sensing elements. One element shall determine velocity and the other shall provide a reference signal to the velocity sensor to compensate for temperature in the air flow. Each flow sensor shall operate independently and shall not affect any other flow sensors in the stations.
 - b. Thermal flow sensor operation shall not be affected by dust particles in quantities typical to HVAC applications. The thermal flow sensors shall be mounted in aluminum probes for duct mounting and adjustable steel struts for fan inlet mounting. The number of sensors and probes shall be selected to provide maximum accuracy.
 - c. Individual flow sensors shall transmit digital flow/temperature information to a microprocessor based control panel which shall total/average signals and output flow signals L/S (CFM) to the host DDC panel. The signals shall be linear 0 to 10 VDC or 4 to 20 mA. The velocity linearity shall be 2% of reading, with a repeatability of 3% of scale, over a fan operating range of 6 to 1 capacity turndown. The station shall not induce a measurable pressure drop or increase the sound emitted by the system.
 - d. A control panel shall be provided with an alphanumeric display of the air volumes and temperatures of the points monitored. A keypad or P.C. link shall allow remote monitoring, trouble shooting or system reconfiguration.

2.9 WIRE AND CONDUIT

- A. Conduit: Electrical metallic tubing EMT with compression type fittings in dry locations; cold rolled steel zinc coated or zinc coated rigid steel with threaded fittings in wet locations or where exposed to weather.
- B. Outlet boxes: Dry locations: sheradized or galvanized drawn steel 100 mm (4 in.) square or octagon with suitable raised cover; Exposed to Weather: threaded hub cast aluminum boxes with gasket plate.

- C. Junction boxes: Sized according to number, size and position of entering raceway; type: suitable for the environment.
- D. Wire:
 - 1. Network: Per controls manufacturer recommendations.
 - 2. Analog Input, Output: Stranded 18 gauge copper twisted shielded.
 - 3. Binary Input, Output: 18 gauge, minimum insulation rating of 600 volts.
 - 4. Class 2: FT-6 without conduit in ceiling plenums; FT-4 in conduit for all other cases.

PART 3 EXECUTION

3.1 GENERAL WORKMANSHIP

- A. Install products to manufacturer's installation instructions.
- B. Install parallel to building walls and floors unless indicated or specified or required by manufacturer's installation instructions.
- C. Mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

3.2 COORDINATION

- A. Submittals: To Part 1: General, Submittals.
- B. Integrate and coordinate work under this section to controls and control devices provided or installed by others.
- C. Each supplier of control product to configure, program, start-up and commission that product to satisfy requirements of Sequence of Operation regardless of where within contract documents product is described or specified.
- D. Resolve compatibility issues between control product provided under this section and those provided under other sections or divisions of this specification.

3.3 WIRING AND CONDUIT

- A. Wire shall be [neatly tie wrapped to] [installed in] conduit mounted to the building structure but must be installed at right angles or parallel to the building. Loose wiring shall only be allowed over a distance of [5 ft.] [1500 mm] but must not pass over lighting fixtures.
- B. Wiring in Equipment Room, between floors, or between concrete walls shall be installed in conduit. Exposed wiring will not be accepted. Conduit shall be installed at right angles or parallel to the building walls.
- C. Should it become necessary to splice field wiring it shall be soldered. If soldering is not possible, approved B type crimp connectors are an acceptable alternative. Wire nuts and Marr connections are not acceptable. Provide a [20 in.] [500 mm] loop length at all splices.

- D. Conceal conduit within finished shafts, ceilings, and walls as required. Install exposed conduit parallel with or at right angles to the building walls.
- E. Plug or cap unused conduit openings and stubs with compatible fittings.
- F. Route all conduit to clear beams, plates, footings and structural members except through column footings and grade beams.
- G. Provide watertight seals at penetrations through outside foundation walls.
- H. Support conduit [1 in.] [25 mm] and smaller to the building with one-hole non-perforated malleable iron or steel pipe straps. Suspend conduits larger than 1 in. on pipe racks with splitting hangers and rods.
- I. Maintain caps on conduit openings throughout construction.
- J. Where conduit is attached to vibrating or rotating equipment, install and anchor flexible metal conduit with a minimum length of [18 in.] [450 mm] and a maximum length of 900 mm (36 in.) in such a manner that vibration and equipment noise will not be transmitted to the rigid conduit.
- K. Where exposed to weather or in damp or wet locations, provide waterproof flexible conduit.
- L. Fill conduit to maximum of 60% of its capacity. Provide a pull rope within the conduit when the installation is complete. Bend conduit to a radius of greater than 3 times the conduit diameter to a maximum of three 1/4 bends permitted between pull boxes.
- M. Wire within cabinets shall be installed in a plastic tray with a cover. Terminate wires to field-removable, modular terminal strips.
- N. All field sensors shall be provided with a flexible conduit connection minimum length of [18 in.] [450mm] and an enclosure for the electrical connections.

3.4 POWER WIRING

- A. Power for Section 23 09 00.00 – Building Automation System (BAS) shall be provided under Electrical Division 26 at 120 VAC 60 Hz single phase and shall terminate in junction boxes installed where shown on electrical and mechanical drawings. Wiring and conduit from these boxes to control devices being electrically powered to be provided by section 23 09 00.00 – Building Automation System (BAS).
- B. Where power for equipment is fed from MCC, 120 VAC power for Section 23 09 00.00 – Building Automation System (BAS) shall also be fed from the MCC from the 120 VAC section. Wiring and conduit from the MCC to control devices being electrically powered to be provided by section 23 09 00.00 – Building Automation System (BAS).

3.5 COMMUNICATION WIRING

- A. Install communication wiring per controls manufacturer recommendations as to type of wire used and segment lengths.

- B. Install communication wiring in conduit and raceways separated from other wiring.
- C. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- D. Each run of communication wiring to be continuous length without splices.

3.6 CABINETS

- A. Install rigidly to wall or to an independent frame installed to the floor slab. Installation to duct, equipment and locations subject to vibration is not accepted.
- B. Cabinets for ASC controllers: Install to terminal equipment. Installation to duct, equipment and locations subject to vibration that could affect controller operation or calibration of control device is not accepted.
- C. Coordinate cabinet locations with other trades and general contractor.

3.7 CONTROL DEVICES

- A. Provide or furnish control devices as indicated on the drawings and to the requirements of this Section and to execute sequence of operation under Section 23 09 23.00 – SEQUENCE OF OPERATION FOR BAS.
- B. Motor Operated Dampers:
 - 1. [Furnish motor operated dampers for installation under Section 23 31.13.00 – DUCTWORK AND SPECIALTIES. Provide supervision on site during installation.] or [Co-ordinate damper actuator sizing with motor operated dampers provided by the Mechanical Contractor.]
 - 2. Install in areas maintained above freezing.
- C. Actuators for Dampers, Electronic:
 - 1. Mounting: Direct coupled to drive shaft or jackshaft using a V bolt design.
- D. Control Valves:
 - 1. Furnish control valves for installation under Section 22 11 13.00 – PIPE, VALVES AND FITTINGS (EXCEPT PLUMBING). Provide supervision on site during installation.
- E. Actuators for Control Valves, Electronic:
 - 1. Factory install or field install actuator to valve body.
- F. Low Limit Electromechanical Thermostat:
 - 1. Install hardwire interlocked to supply fan starter for respective system.
 - 2. Provide according to Section 23 09 23.00 – SEQUENCE OF OPERATION FOR BAS.
 - 3. Shut down the fan when duct temperature is equal to or less than [35 deg. F] [1.67 deg. C].
 - 4. Install to adequately cover potential areas of low level stratification. Provide one low-limit thermostat for each [25 sq ft] [2.8 sq M] of duct cross section. Mount sensing element on plastic clips.

- G. High Limit Electromechanical Thermostat:
 - 1. Install hardwire interlocked to fan starters for respective system.
 - 2. Shut down the fans when duct temperature is equal to or greater than [125 deg. F] [51.7 deg. C].
 - 3. Provide one high-limit thermostat for each [40 sq ft] [3.7 sq M] of duct cross section.

- H. Electromechanical Thermostats and Temperature Sensors:
 - 1. Furnish sensing wells for installation under Section 22 11 13.00 – PIPE, VALVES AND FITTINGS (EXCEPT PLUMBING). Provide supervision on site during installation.
 - 2. Samples: Provide for wall mount type to Part 1: Submittals, Samples.
 - 3. Wall Mount Type:
 - a. Cover Color: White.
 - b. Install to furred-in columns and permanent walls on concealed junction boxes supported by wall framing or surface mount [4 ft] [1.2 m] above finished floor. Installation to mobile and temporary partitions is not acceptable.
 - c. Installation to exposed architectural concrete columns and walls is not acceptable, unless otherwise indicated or specified. For installation to concrete, set conduit in place before pouring of concrete.
 - 4. Single Point Type, Duct:
 - a. Provide sufficient contact with process fluid to measure average conditions.
 - b. Apply pipe sealing compound to plug thread.
 - 5. Single Point Type, Pipe:
 - a. Provide sufficient contact with process fluid to measure average conditions.
 - b. Install with heat conducting fluid in wells.
 - 6. Outdoor Type:
 - a. Install to north side of building away from sources of heat such as lamps and exhaust vents; to greater than [5 ft] [1500 mm] above horizontal surfaces.
 - b. Where indicated or specified for installation in outside air intake, locate so as not to be affected by exhaust air flow or reverse flow.
 - c. Provide solar shield. Install shield to open downward.
 - d. Seal interior of conduit at penetration through exterior wall.

- I. Guards for Thermostats and Temperature Sensors:
 - 1. Provide for wall mount sensors and thermostats where indicated on the drawings.
 - 2. Samples: Provide to Part 1: Submittals, Samples.

- J. Air Static Pressure Sensors:
 - 1. Duct Mount: Pipe the high-pressure tap to the duct using a pitot tube.
 - 2. Building Static: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building and install with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - 3. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.

- K. Wet/Wet Differential Pressure Sensors:
 - 1. Differential pressure sensors shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.

- L. Relative Humidity Sensors:

1. Install to requirements for Electric Thermostats and Temperature Sensors.
- M. AC Current Sensors and Transducers:
1. Install in motor starter cabinet.
- N. CO Sensors:
1. Mount the sensor 4-6 feet from the floor.
 2. Provide sufficient number of sensors for full coverage of the monitored area.
- O. NO2 Sensors:
1. Use two sensors per zone, mount one of the sensors 1 foot from the floor and the other 1 foot from the ceiling.
 2. Provide sufficient number of sensors for full coverage of the monitored area.
- P. Water Flow Meters:
1. The installing contractor is responsible for providing suitable mating flanges and any required reducer/expander.
- Q. Gas Meter Connection:
1. This contractor shall provide connection from BAS to standard output of a gas meter transducer provided by local authorities.
- R. Air Flow Sensors, Fan Bell Mouth:
1. Coordinate installation of air flow sensors to inlet of fans with fan manufacturer.
- S. Air Flow Sensors, Duct Mount:
1. Furnish duct mount air flow sensors for installation under Section 23 31 13.00 – DUCTWORK AND SPECIALTIES. Provide supervision on site during installation.

3.8 IDENTIFICATION

- A. All wires shall be tagged at both ends. The tagging shall identify the device it is connected to. Use of the point object name is acceptable.
- B. All wires passing through a junction box shall be tagged with the device identity or its termination point.
- C. The junction boxes shall be tagged “BAS” with a sequential number suffix.
- D. Label wires, control devices, controllers.

3.9 TESTING AND COMMISSIONING

- A. Test and commission the BAS prior to the Demonstration and Acceptance Test.
- B. Prepare test forms which shall identify each test. The forms shall be sub-divided into points, controllers, programs, loops, networks and graphics.
- C. Device tests shall identify and confirm successful completion of the following:

1. Device installation.
 2. Device identification.
 3. Device calibration.
 4. Device operation.
 5. Wiring to device, connection details and wire type.
 6. Validation of the device signal at the controller.
- D. Controller tests shall identify and confirm successful completion of the following:
1. Controller installation.
 2. Power source and grounding.
 3. Make, model and serial number, software revisions.
- E. Software tests shall identify and confirm successful completion of the following:
1. Custom application programs.
 2. Energy management programs.
- F. Loop tuning tests shall identify and confirm successful completion of the following:
1. Loop input signal.
 2. Loop output signal.
 3. Set point adjustment.
 4. Device response.
 5. Control response.
- G. Network communication tests shall identify and confirm successful completion of the following:
1. Primary network communication function.

3.10 DEMONSTRATION

- A. When all tests have been completed and the documentation completed, request a meeting with the Consultant and Owner. Provide at this meeting a demonstration that all systems on the BAS are operating. At the successful conclusion of this demonstration the Consultant will allow the Acceptance Test to begin.
- B. At the discretion of the Consultant and Owner, demonstrate up to 10% of the tests described in Part 3: Execution, Testing and Commissioning and witnessed by the Consultant and Owner. Should any test fail then the BAS Contractor shall retest the failed components or functionality.

3.11 ACCEPTANCE TEST

- A. When Testing and Commissioning and the Demonstration have been completed satisfactorily the Consultant will give approval for commencement of the Acceptance Test.
- B. Notify the Owner in writing 2 weeks prior to the testing date.
- C. Furnish a new operator's log book to building operators.
- D. The Acceptance Test period shall be 21 days. Visit the site each morning, Monday to Friday, to review the BAS operation and the building operators log book which contains records of all problems experienced by the building operators, the point object name and value and time and

date of failure, and time of return to service. During the first 14 days of the acceptance test, any operational failures due to malfunction of wiring, controllers or Operator Interfaces, shall designate a restart to testing for 21 days. Any failure of control devices shall be corrected and the acceptance test shall continue from the date the failure has been corrected. During the last 7 days of testing, no failures of any kind will be accepted, or the last 7 days shall be repeated.

- E. The BAS shall not be accepted or considered substantially complete until the Acceptance Test is successfully completed.
- F. At the successful completion of the Acceptance Test, provide a certificate of completion.

3.12 INSTRUCTION AND TRAINING

- A. Provide [three] one day[s] of instruction during the BAS installation. This instruction shall include: identification of devices, power sources, conduit and wire installation, the operation of controlled devices and how they interface with the mechanical systems.
- B. Provide an additional [five] one day[s] of instruction that shall cover the operation and maintenance of the BAS systems. The instruction shall be conducted in the building and videotaped by the Owner. Submit training course outline for review by the Consultant before completion of the BAS and before instruction period commences. Instruction shall include:
 - 1. Operation and maintenance of Operator Interfaces.
 - 2. Operation and maintenance of controllers.
 - 3. Custom Application Programming software.
 - 4. Point objects addressing and commanding.
 - 5. Custom reporting.
 - 6. Creating and modifying graphics.
 - 7. Data base modification, deletion and back-up and restore operations.
 - 8. System malfunction diagnostics and maintenance.
 - 9. Control devices, operation and maintenance.
- C. Provide an additional three days of training that may be scheduled up to six months after BAS Acceptance. The Owner will advise the BAS Contractor of the training content required.
- D. One day shall be 7.5 working hours excluding one hour lunch break.

END OF SECTION 23-09-00

Instrumentation and Controls For HVAC

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

SECTION 23 09 00 – INSTRUMENTATION AND CONTROLS FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Requirements of Division 01 including, but not limited to, General Requirements, Submittal Procedures, Quality Requirements, Product Requirements, Substitution Procedures, Operation and Maintenance Data, Demonstration and Training shall apply to all work under this section.
- B. All work of this Section shall be coordinated and provided by the single Building Management System (BMS) Contractor.
- C. All 120V power and control wiring/conduit associated with the bus shall be provided by the control contractor. This includes but not limited to VAV's, transformers, relays, sensors, valves, actuators, dampers, controllers, etc. This shall include any control or power (120V) cabling for equipment manufacturers packaged control panels, sensors, relays, etc.
- D. The control contractor shall provide interconnecting cabling between the equipment and the manufactures control panel.
- E. This Section includes the Building Management System (BMS) control equipment for HVAC systems and components, including open protocol control components for terminal heating and cooling units.
- F. Related Sections include the following:
 - 1. Fire Alarm Systems.
 - 2. Commissioning.
 - 3. Basic Mechanical Requirements.
 - 4. Refrigeration Equipment.
 - 5. Air Handling Equipment.
 - 6. Test and Balance.
 - 7. Basic Electrical Requirements.
 - 8. Cables, Low Voltage 600 Volts and below.
 - 9. Wiring Devices
 - 10. Basic Electrical Materials.
 - 11. Uninterruptable Power Supply.
 - 12. Emergency Systems.

1.2 SCOPE

- A. The Building Management System (BMS) shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the FMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

- B. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.
- C. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, raceways, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in this Section which are required for the complete, fully functional and commissioned BMS.
- D. Provide a complete, neat and workmanlike installation. Use only employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
- E. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.
- F. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions.
 - 2. Enterprise-level information and control access.
 - 3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 - 4. Diagnostic monitoring and reporting of BMS functions.
 - 5. Offsite monitoring and management access.
 - 6. Energy management
 - 7. Standard applications for terminal HVAC systems.

1.3 DEFINITIONS

- A. ARP: Address Resolution Protocol
- B. ASC: Application Specific Controller.
- C. BMS: Building Management System
- D. CAC: Custom Application Controller.
- E. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
- F. DDC: Direct Digital Control
- G. DDE: Dynamic Data Exchange
- H. FTT: Free Topology Transceivers

- I. GUI: Graphical User Interface
- J. HMI: Human Machine Interface
- K. HVAC: Heating, Ventilation, and Air Conditioning
- L. LAN: Local Area Network
- M. MER: Mechanical Equipment Room
- N. ODBC: Open DataBase Connectivity
- O. PID: Proportional, Integral, Derivative
- P. PES: Portable Engineering Station
- Q. POT: Portable Operator's Terminal
- R. SNVT: Standard Network Variables Types
- S. SQL: Structured Query Language
- T. UDP: User Datagram Protocol
- U. UNC: Universal Network Controller
- V. VAV: Variable Air Volume Box

1.4 System Description Ethernet (IEEE 802.3), peer-to-peer CSMA/CD

- A. Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature control system, utilizing a high speed peer to peer network of interoperable Direct Digital Controls (DDC), Graphical User Interface (GUI) with color graphic displays available on at least 64 client computers, and electronic interfaces and actuation devices, as shown on the drawings and as described herein.
- B. The Local Area Network (LAN) shall be either a 10 or 100 Mbps Ethernet network supporting BACnet, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Universal Network Controllers (UNCs), user workstations and a local host computer system.
- C. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.
- D. The system will consist of an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol, as the common communication protocol between all controllers and integral ANSI / ASHRAE™ Standard 135-1995, BACnet functionality to assure interoperability between all system components. Both the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-

1995, BACnet protocol are required to assure that the project is fully supported by the two leading HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs.

- E. Where necessary or desired, LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth.
 - 1. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide-lines for such encapsulation and shall be based on industry standard protocols.
 - 2. The products used in constructing the BMS shall be LonMark™ compliant.
 - 3. In those instances in which Lon-Mark™ devices are not available, the BMS contractor shall provide LonWorks™ devices with application source code, device resource files, and external interface definitions.

- F. The software tools required to network manage the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-1995, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, that is required to meet the functional intent, shall be provided without additional cost to the Owner. Minimum BACnet compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet/Ethernet IP.

- G. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel.
 - 1. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs.
 - 2. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage.
 - a. This data shall reside on a supplier-installed server for all database access.
 - b. Systems requiring proprietary database and user interface programs shall not be acceptable.
 - c. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network.
 - d. Systems employing a "flat" single tiered architecture shall not be acceptable.

- H. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of Invensys Factory office. Invensys Factory office shall have a minimum of 5 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the employees of Invensys Factory office. Supplier shall have an in place support facility within 25 miles of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment.

- I. Provide a Portable Operator’s Terminal (POT) color display personnel computer, software, and interfaces to provide uploading/downloading of Custom Application Controller and Application Specific Controllers databases, monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs, monitoring and overrides of all controller physical input/output points, and editing of controller resident time schedules. POT connectivity shall be via digital wall sensor connected to controller.
 - J. BACnet protocol will be acceptable in lieu of LonTalk.
- 1.5 INSTALLATION OF PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION.
- A. Hydronic Piping:
 - 1. Control Valves.
 - 2. Flow Switches.
 - 3. Temperature Sensor Wells and Sockets.
 - 4. Flowmeters.
 - B. Ductwork Accessories:
 - 1. Automatic Dampers.
 - 2. Airflow Stations.
 - 3. Terminal Unit Controls.
- 1.6 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION.
- A. Rooftop Air Handling Equipment:
 - 1. Thermostats.
 - 2. Duct Static Pressure Sensors.
- 1.7 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION.
- A. Chiller Controls
 - B. Boiler Controls
 - C. Packaged Rooftop Equipment:
 - 1. Discharge Air Temperature Control.
 - 2. Economizer Control.
 - 3. Volume Control.
 - D. Unit Ventilators, Heat Pumps, and Fan Coils Units:
 - 1. Set Point Reset.
 - 2. Day/Night Indexing.
 - E. VAV Terminal Units:
 - 1. Cross-Flow Velocity Sensor.
 - F. Variable Frequency Drives.

- G. Fire Alarm System.
 - 1. Smoke Detectors (duct).
- H. Lighting.
 - 1. Lighting Control Units and Intelligent Devices.
- I. Security Systems.
- J. Security Control Units and Intelligent Devices.

1.8 REFERENCES

- A. All work shall conform to the following Codes and Standards, as applicable:
 - 1. National Fire Protection Association (NFPA) Standards.
 - 2. International Mechanical Code 2006
 - 3. International Building Code 2006
 - 4. National Electric Code (NEC) and applicable local Electric Code.
 - 5. Underwriters Laboratories (UL) listing and labels.
 - 6. UL 864 UUKL Smoke Control
 - 7. UL 268 Smoke Detectors.
 - 8. UL 916 Energy Management
 - 9. NFPA 70 - National Electrical Code.
 - 10. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
 - 11. NFPA 92A and 92B Smoke Purge/Control Equipment.
 - 12. Factory Mutual (FM).
 - 13. American National Standards Institute (ANSI).
 - 14. National Electric Manufacturer's Association (NEMA).
 - 15. American Society of Mechanical Engineers (ASME).
 - 16. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
 - 17. Air Movement and Control Association (AMCA).
 - 18. Institute of Electrical and Electronic Engineers (IEEE).
 - 19. American Standard Code for Information Interchange (ASCII).
 - 20. Electronics Industries Association (EIA).
 - 21. Occupational Safety and Health Administration (OSHA).
 - 22. American Society for Testing and Materials (ASTM).
 - 23. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
 - 24. Americans Disability Act (ADA)
 - 25. ANSI/EIA 909.1-A-1999 (LonWorks)
 - 26. ANSI/ASHRAE Standard 195-2004 (BACnet)
- B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
- C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.9 SUBMITTALS.

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. Each control device labeled with setting or adjustable range of control.
- 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. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 3. Details of control panel faces, including controls, instruments, and labeling.
 4. Written description of sequence of operation.
 5. Schedule of dampers including size, leakage, and flow characteristics.
 6. Schedule of valves including close-off and flow characteristics.
 7. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
 8. Listing of connected data points, including connected control unit and input device.
 9. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 10. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
- C. External Interface Files: XIF files or object diagrams for each DDC system component (Custom Application Controller and Application Specific Controller) proposed.
- D. ANSI / ASHRAE™ Standard 135-1995, BACnet PIC Statement: Proof of Compliance Level 3 or higher is required to protect building owner by reducing future maintenance and expansion costs.
- E. Samples: For each color required, of each type of thermostat cover.
- F. Software and Firmware Operational Documentation: Include the following:
1. Engineering, Installation, Operation and Maintenance manuals.
 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.
 5. Licenses, guarantee, and warranty documents for all equipment and systems.
- G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- H. Maintenance Data: For systems to include in maintenance manuals specified in Division 01. Include the following:
1. Maintenance instructions and lists of spare parts for each type of control device and compressed air station.
 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 5. Calibration records and list of set points.

- I. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- J. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.
- K. All GUI screen captures for approval after all above information has been reviewed.

1.10 QUALITY ASSURANCE.

- A. Bids by wholesalers and non-franchised contractors shall not be acceptable.
- B. The system manufacturer shall, as a minimum, manufacture and supply the Custom Application Controller, Application Specific Controller, Graphical User Interface, damper actuators, and valve actuator assemblies.
- C. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the direct employment of the temperature control system manufacturer.
- D. The BMS Contractor shall have a complete maintenance and support services on a 24 hour, 7-day-a-week basis.
- E. The Building Management System contractor shall have a full service facility within 25 miles of the project that is staffed with engineers trained in Integrating Interoperable Systems and technicians fully capable of providing LonWorks instructions and routine emergency maintenance service on all system components.
- F. Mechanical equipment manufacturers desiring to provide DDC type controls as factory mounted equipment shall provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the BMS contractor.
- G. 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.
- H. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- I. Comply with National Electric Code, UL-916 Energy Management Systems, LonMark™, ULC, FCC Part 15, subpart J, Class B Computing Devices.
- J. Comply with EIA Standard 709.1 LonTalk™ protocol for DDC system control components.

1.11 DELIVERY, STORAGE AND HANDLING.

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.12 COORDINATION.

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor-Control Centers," "Panelboards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.
- C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- D. Coordinate location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 -Cast-in-Place Concrete.
- E. Coordinate with the Owner's IT department on locations for UNC's, ethernet communication cabling and TCP/IP addresses.

1.13 WARRANTY AND MAINTENANCE.

- A. All components, system software, and parts furnished and installed by the BMS contractor shall be guaranteed against defects in materials and workmanship for 2 years of substantial completion. Labor to repair, reprogram, or replace these components shall be furnished by the BMS contractor at no charge during normal working hours during the warranty period. Materials furnished but not installed by the BMS contractor shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 hours standard working hours.

1.14 RECORD DOCUMENTATION

- A. Operation and Maintenance Manuals
 - 1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BMS provided:
 - a. Table of contents.
 - b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
 - c. Manufacturer's product data sheets or catalog pages for all products including software.
 - d. System Operator's manuals.
 - e. Archive copy of all site-specific databases and sequences.
 - f. BMS network diagrams.
 - g. Interfaces to all third-party products and work by other trades.
 - 2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of

contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

1.15 OWNERSHIP OF PROPRIETARY MATERIAL.

- A. The owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software. All project developed software and documentation shall become the property of the owner. These include, but are not limited to project graphic images, record drawings, project database, project specific application programming code, and all other associated documentation.

PART 2 PRODUCTS

2.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- A. Electric, Electronic, and DDC Systems:

2.2 DDC EQUIPMENT

- A. Workstation Server Hardware Station: IBM-compatible microcomputer with minimum configuration as follows:
 - 1. Processor: 2-Intel Pentium III, 1.26 GHz., or faster.
 - 2. Random-Access Memory: 2GB ECC SDRAM., minimum.
 - 3. Graphics: Super video graphic adapter (SVGA), minimum 1024 x 768 pixels, 2.0-MB EDO video memory.
 - 4. Monitor: 17 inches (17.4 viewable, minimum), non-interlaced, color, with maximum 0.28-mm dot pitch.
 - 5. Keyboard: QWERTY, 105 keys in ergonomic shape.
 - 6. Floppy-Disk Drives: 1.44 MB.
 - 7. Hard-Disk Drive: 73GB 10K RPM Ultra 160 SCSI Hard Drive, minimum.
 - 8. Embedded Intel PRO/100+ Server Adapter for TCP/IP Communication
 - 9. DVD-ROM Drive: 24X, IDE CD-ROM with software decoding.
 - 10. Mouse: Two button.
 - 11. Tape Backup: 110/220GB, Controller Included, Internal, minimum.
 - 12. Operating System: Microsoft Windows NT/2000.
- B. Provide 2 Color Printers, ink-jet type. Each printer shall have:
 - 1. Print Head: 1440 x 1440 dpi photo quality color resolution.
 - 2. Internal Memory Buffer: 32KB.
 - 3. Paper Handling: Minimum of 100 sheets.
 - 4. Print Speed: Minimum of 8 ppm in black and 4 ppm in color.
- C. UPS (uninterruptable power supply) shall be installed at the server Size for 50% spare capacity with sufficient capacity to allow emergency power for a minimum of 10 minutes backup.

- D. GUI Server Application Software: Input/output capability from operator station for monitoring and controlling all of the points listed in the input/output point list. The operator shall be able to monitor and access all points by means of clear concise English names without having to understand or reference hardware point locations or controller programs.
1. Operating System: The GUI shall run on Microsoft Windows NT Workstation 4.0, Service Pack 4, Windows 2000, or later.
 2. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
 3. The GUI shall have the contract drawing floor plans with associated ductwork, VAV's, thermostats, AHU's, etc. The GUI shall be clear and easy to view without any distorted images. Provide color coded zones that indicate individual zones. Provide separate individual screens that will show chiller plant, boiler plants, AHU's, VAV's, Generators, etc.
 4. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
 - a. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
 - b. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
 - c. Graphics shall support layering and each graphic object shall be configurable for assignment to one a layer. A minimum of six layers shall be supported.
 - d. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
 - 1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 5. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 6. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.
 7. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
 - a. Create, delete or modify control strategies.
 - b. Add/delete objects to the system.
 - c. Tune control loops through the adjustment of control loop parameters.
 - d. Enable or disable control strategies.
 - e. Generate hard copy records or control strategies on a printer.
 - f. Select points to be alarmable and define the alarm state.

- g. Select points to be trended over a period of time and initiate the recording of values automatically.
- 8. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
- 9. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- 10. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
- 11. Alarm Console
 - a. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
 - b. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

E. Web Browser Clients

- 1. The system shall be capable of supporting 64 clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, are only acceptable if 64 licensed copies of the client machine software are provided, installed, and tested.
- 2. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall only be acceptable if 64 workstations or workstation hardware upgrades are provided.
- 3. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- 4. The Web browser client shall support at a minimum, the following functions:
 - a. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

- b. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
- c. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
- d. Storage of the graphical screens shall be in the Building Control Units (BC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
- e. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
- f. User’s shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - 1) Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 - a) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - b) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - 2) Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 - 3) View logs and charts
 - 4) View and acknowledge alarms
- g. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
- h. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

F. Portable Engineering Stations

- 1. Provide a Portable Engineering Station (PES) color display personal computer, software, and interfaces to provide; uploading/downloading of Custom Application Controller and Application Specific Controllers databases, monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs, monitoring and overrides of all controller physical input/output points, and editing of controller resident time schedules. PES connectivity shall be via digital wall sensor connected to controller.
- 2. The Portable Engineering Station shall use Visio and all programming shall be graphical.
- 3. The Portable Engineering Station shall be able to access any other controller on that segment of the LAN.
- 4. Connection of a PES to the Custom Application Controller or Application Specific Controller shall not interfere with normal network operation in any way, prevent alarms from being transmitted or centrally initiated commands from being executed.
- 5. If the PES cannot be used for both the CAC’s and ASC’s, provide, in addition to the PES, the separate color display personal computer(s), software, and interfaces required to provide full PES functionality for both the CAC’s and ASC’s.
- 6. Hardware for the PES shall consist of the following:

- a. Pentium III processor
 - b. Large 15” UXGA active matrix (TFT) display
 - c. 256 MB 133 MHz SDRAM memory
 - d. 60 GB internal hard drive
 - e. Ethernet 10/1000
 - f. Integrated 56 Kbps modem g. PCMCIA LON Card
7. Functionality of the PES connected to any CAC or ASC shall include:
- a. Uploads and downloads of CAC and ASC Controller databases.
 - b. Uploads and downloads of CAC and ASC LonMark™ SNVT nci values.
 - c. Editing of LonMark™ SNVT nci values for minor equipment operational parameters (including minimum on/off and delay times, changeover values, minimum position setpoints, etc.). All such mechanical equipment editable nci values shall contain internal CAC and ASC Controller safety range limits to prevent accidental entry of out of range or invalid values.
 - d. Monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs and test overrides of nvi SNVTs.
 - e. Monitoring and overrides of all controller physical input/output points including timed overrides that automatically revert back to their normal value.
 - f. Display of digital sensor values including diagnostics and calibration.
 - g. Editing of controller time/date.
 - h. Editing and overrides of resident Controller time schedules.
 - i. LonMark™ information including program ID, Neuron ID, domain, subnet, and node.
- G. Portable Operator’s Terminal
1. Provide a Portable Operator’s Terminal (POT) color display personal computer, software, and interfaces to provide; uploading/downloading of Custom Application Controller and Application Specific Controllers databases, monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs, monitoring and overrides of all controller physical input/output points, and editing of controller resident time schedules. POT connectivity shall be via digital wall sensor connected to controller.
 2. Connection of a POT to the Custom Application Controller or Application Specific Controller shall not interfere with normal network operation in any way, prevent alarms from being transmitted or centrally initiated commands from being executed.
 3. If the POT cannot be used for both the CAC’s and ASC’s, provide, in addition to the POT, the separate color display personal computer(s), software, and interfaces required to provide full POT functionality for both the CAC’s and ASC’s.
 4. Functionality of the POT connected to any CAC or ASC shall include:
 - a. Uploads and downloads of CAC and ASC Controller databases.
 - b. Uploads and downloads of CAC and ASC LonMark™ SNVT nci values.
 - c. Editing of LonMark™ SNVT nci values for minor equipment operational parameters (including minimum on/off and delay times, changeover values, minimum position setpoints, etc.). All such mechanical equipment editable nci values shall contain internal CAC and ASC Controller safety range limits to prevent accidental entry of out of range or invalid values.
 - d. Monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs and test overrides of nvi SNVTs.
 - e. Monitoring and overrides of all controller physical input/output points including timed overrides that automatically revert back to their normal value.

- f. Display of digital sensor values including diagnostics and calibration.
- g. Editing of controller time/date.
- h. Editing and overrides of resident Controller time schedules.
- i. LonMark™ information including program ID, Neuron ID, domain, subnet, and node.

H. Control Units General:

Provide an adequate number of control units to achieve monitoring and control of all data points specified and necessary to satisfy the sequence of operation for all mechanical systems shown on the plans. Provide a minimum of one separate controller for each AHU or other HVAC system. Multiple DDC controllers may control one system provided that all points associated with individual control loops are assigned to the same DDC controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement. Each of the following panel types shall meet the following requirements.

- 1. Controllers shall be suitable for the anticipated ambient conditions.
 - a. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40°F to 140°F and 5 to 95% RH, non condensing.
 - b. Controllers used in conditioned ambient space shall be mounted in dustproof enclosures, and shall be rated for operation at 32°F to 122°F and 5 to 95% RH, non condensing.
- 2. Serviceability: Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
- 3. Memory: The Control Units shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- 4. Diagnostics: The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode and generate an alarm notification.
- 5. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 ft.
- 6. Automatic staggered restart of field equipment after restoration of power and short cycle protection.

I. Universal Network Controllers (UNC)

- 1. The Universal Network Controllers (UNC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the UNC. It shall be capable of executing application control programs to provide:
 - a. Calendar functions
 - b. Scheduling
 - c. Trending
 - d. Alarm monitoring and routing
 - e. Time synchronization by means of an Atomic Clock Internet site including automatic synchronization
 - f. Integration of LonWorks controller data and BACnet controller data g. Network Management functions for all LonWorks based devices

2. Power fail Protection - All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming.
3. The Universal Network Controller UNC-501 must provide the following hardware features as a minimum:
 - a. One Ethernet Port – 10/100 Mbps
 - b. One RS-232 port
 - c. One RS-232/RS485 port selectable
 - d. One LonWorks Interface Port – 78KB FTT-10A with Weidmuller connector
 - e. Power supply 24 VAC or 24 VDC
 - f. Battery Backup
 - g. Real-time clock
 - h. Processor @ 200 MHz or greater
 - i. 8 Mb flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
 - j. 64 Mb Ram or greater
4. The Universal Network Controller UNC 502 must provide the following hardware features as a minimum:
 - a. One Ethernet Port – 10/100 Mbps
 - b. Two RS-232 ports
 - c. Two RS-RS485 ports electrically isolated
 - d. One LonWorks Interface Port – 78KB FTT-10A with Weidmuller connector
 - e. Power supply 24 VAC or 24 VDC
 - f. Battery Backup
 - g. Real-time clock
 - h. Processor @ 200 MHz or greater
 - i. 8 Mb flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
 - j. 64 Mb Ram or greater
5. The Universal Network Controller UNC 600 must provide the following hardware features as a minimum:
 - a. One Ethernet Port – 10/100 Mbps
 - b. Two RS-232 ports
 - c. One LonWorks Interface Port – 78KB FTT-10A with Weidmuller connector
 - d. Power supply 120 VAC
 - e. Battery Backup
 - f. Real-time clock
 - g. Processor 550 MHz or greater
 - h. Minimum 3 GB IDE hard drive
 - i. 128 Mb Ram or greater
 - j. Operating system Windows NT 4.0 Embedded with Microsoft Java VM
6. The UNC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the UNC shall be an ODBC compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
7. The UNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 64 simultaneous users.

8. Event Alarm Notification and actions
 - a. The UNC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 - b. The UNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
 - c. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - 1) To alarm
 - 2) Return to normal
 - 3) To fault
 - d. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
 - e. Provide timed (schedule) routing of alarms by class, object, group, or node.
 - f. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
 - g. Control equipment and network failures shall be treated as alarms and annunciated.
 - h. Alarms shall be annunciated in any of the following manners as defined by the user:
 - 1) Screen message text
 - 2) Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a) Day of week
 - b) Time of day
 - c) Recipient
 - i. Pagers via paging services that initiate a page on receipt of email message
 - j. Graphic with flashing alarm object(s)
 - k. Printed message, routed directly to a dedicated alarm printer
 - l. The following shall be recorded by the UNC for each alarm (at a minimum):
 - 1) Time and date
 - 2) Location (building, floor, zone, office number, etc.)
 - 3) Equipment (air handler #, accessway, etc.)
 - 4) Acknowledge time, date, and user who issued acknowledgement.
 - 5) Number of occurrences since last acknowledgement.
 - m. Alarm actions may be initiated by user defined programmable objects created for that purpose.
 - n. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
 - o. A log of all alarms shall be maintained by the UNC and/or a server (if configured in the system) and shall be available for review by the user.
 - p. Provide a “query” feature to allow review of specific alarms by user defined parameters.
 - q. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
 - r. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.
9. Data Collection and Storage

- a. The UNC shall have the ability to collect data for any property of any object and store this data for future use.
 - b. The data collection shall be performed by log objects, resident in the UNC that shall have, at a minimum, the following configurable properties:
 - 1) Designating the log as interval or deviation.
 - 2) For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
 - 3) For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
 - 4) For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
 - 5) Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
10. All log data shall be stored in a relational database in the UNC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
 11. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
 12. All log data shall be available to the user in the following data formats:
 - a. HTML
 - b. XML
 - c. Plain Text
 - d. Comma or tab separated values
 13. Systems that do not provide log data in HTML and XML formats at a minimum shall provide as an alternative Microsoft SQL Server, Oracle 8i or Express, Hyperion Solutions™ SQL Server.
 14. The UNC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other UNC on the network. Provide the ability to configure the following archiving properties, at a minimum:
 - a. Archive on time of day
 - b. Archive on user-defined number of data stores in the log (buffer size)
 - c. Archive when log has reached its user-defined capacity of data stores
 - d. Provide ability to clear logs once archived
 15. AUDIT LOG
 - a. Provide and maintain an Audit Log that tracks all activities performed on the UNC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the UNC), to another UNC on the network, or to a server. For each log entry, provide the following data:
 - 1) Time and date
 - 2) User ID
 - 3) Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
 16. DATABASE BACKUP AND STORAGE
 - a. The UNC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
 - b. Copies of the current database and, at the most recently saved database shall be stored in the UNC. The age of the most recently saved database is dependent on the user-defined database save interval.

- c. The UNC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

J. Custom Application Control Units:

Modular, comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control applications. CAC's shall be provided for Roof Top Units, Boiler Plant, Chiller Plant, Air Handling Units, and other applications as shown on drawings and shall have published LonWorks™ application source code, device resource files and external interface definitions

1. Units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, enthalpy calculation, counters, interlocks, ramps, drivers, schedules, calendars, OSS, compare, limit, curve fit, and alarms.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Peer to peer primary network level communications supporting at least 200 LonMark™ Standard Network Variables (SNVTs) per CAC utilizing at least 100 different SNVT types as documented by the LonMark™ Interoperability Association to assure present and future compatibility with third party LonMark™ devices. The 200 LonMark™ SNVTs, minimum, must be configurable in any combination – all inputs or all outputs or any combination of input/outputs in any combination of the 100 different, minimum, SNVT types. The XIF SNVT order shall be definable, rather than random, to provide logical and effective LonMark™ network management. With the submittal package, contractor shall provide CAC performance data that specifies the exact maximum number of SNVTs available in any combination and a list of all available SNVT types including the LonMark™ Interoperability Association SNVT number.
 - b. Automatic communications loss detection to maintain normal control functionality regardless of available network communications.
 - c. Discrete/digital, analog, and pulse input/outputs.
 - d. Monitoring, controlling, or addressing data points.
 - e. Local energy management control strategies
 - f. Incorporate internal customizable safeties and limit to prevent third party LonMark™ tools from providing improper and unrealistic inputs to CAC 's.
3. Local operator interface port provides for download from and connection to portable workstation.
4. Communication: The Custom Application Controller shall communicate via the Primary Controller Network between BMS Controllers and other LonWorks™ devices. CAC's shall communicate with the Building Controller and ASC's at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 709.1).
5. Power fail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming.
6. Human Machine Interface (HMI): Provide a HMI for each controller that shall control and monitor the temperature, pressure, fan status, manual override, CO2 and setpoint adjustment. HMI shall be LCD display. HMI shall also be able to control the local equipment upon the loss of communication with the UNC.

K. Application Specific Control Units:

Single board construction comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control and unitary applications. ASCs shall be provided for Unit Ventilators, Fan Coils, Heat Pumps, Rooftop Units, Air Handling Units, and other applications as shown on the drawings. To assure complete interoperability, all ASCs firmware shall support all mandatory and all optional LonMark™ Standard Network Variables (SNVTs) for their LonMark™ profile as documented by the LonMark™ Interoperability Association. Bidder shall provide proof of ASC compliance for all the mandatory and all optional LonMark™ SNVTs. ASCs shall be based on the Echelon Neuron 3150 microprocessor working with the ASCs stand alone control program.

1. Units monitor or control each input/output point; process information; and download from the operator station.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Peer to peer primary network level communications with automatic communications loss detection to maintain normal control functionality regardless of available network communications.
 - b. Discrete/digital, analog, and pulse input/output.
 - c. Monitoring, controlling, or addressing data points.
 - d. Appropriate LonMark™ profiles for specific unitary applications.
 - e. Support for all mandatory and optional LonMark™ Standard Network Variable Types (SNVTs) for their LonMark™ profile as documented by the LonMark™ Interoperability Association
 - f. Internal customizable safeties and limits to prevent third party LonMark™ tools from providing improper and unrealistic inputs to ASC's.
3. Local operator interface port located on ASC and ASC sensor provides for download from or upload to portable workstation. All Lon bus devices shall be accessible from either port.
4. Communication: ASC's shall communicate with the Building Controller and CAC's at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 709.1).
5. ASC units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, counters, interlocks, compare, limit, and alarms.
6. Power fail Protection - All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming.
7. All ASC Controller setpoints shall be digital display setpoints with dual setpoint limits (integral hard limits which the user cannot exceed above and below and independent soft limits which are hidden from the user). All digital setpoints shall be network retentive after power outages and after replacement of sensor.
8. Human Machine Interface (HMI): Provide a HMI for each controller that shall control and monitor the temperature, pressure, fan status, manual override, CO2 and setpoint adjustment. HMI shall be LCD display. HMI shall also be able to control the local equipment upon the loss of communication with the UNC.

L. ASC Room Sensor

1. The ASC Sensor shall provide room temperature value and humidity to the ASC.

2. The ASC Sensor shall connect directly to the ASC and shall not utilize any of the I/O points of the controller.
3. The ASC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive.
4. There shall be one ASC Sensor per floor wired so that the communication jack will provide for a connection to the LON communication trunk to which the ASC controller is connected.
5. By connecting to this ASC Sensor, the connected controller, and all other devices on the LON bus shall be accessible by the Portable Engineering Station.
6. The ASC Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering.
7. The ASC Sensor shall allow for the customization of the color on the esthetic covering as a standard offering.
8. The ASC Sensor shall be supplied in the following manner:
 - a. LCD display for viewing up to four possible displays, each showing a current value in the ASC or on the network.
 - b. Tenant override to allow timed override of unoccupied to occupied mode of operation.
 - c. LED indication of override state
 - d. Icons shall be utilized to represent sensor and controller function status, affording independence from a single language for use interface.
 - e. User interface with the ASC Sensor shall be provided as a configurable function, and shall offer password protection for access to network variable editing.
 - f. Six buttons to provide the following functions:
 - 1) Selection and adjustment of up to four setpoints (Setpoint Key)
 - 2) Selection of up to two HVAC modes (Mode Key)
 - 3) Selection of up to two fan modes (Fan Key)
 - g. ASHRAE 95 compliance (LCD display and sub-base functionality)
 - h. The room sensor shall provide access to additional diagnostic data from a sensor- user keypad request. This Diagnostic mode is displayed on the LCD screens and includes separate displays for the controllers:
 - 1) Subnet and Node Address
 - 2) Errors
 - 3) Alarms
 - 4) Temperature Offset

M. ASC – VAV Controller Functionality.

Controls shall be microprocessor based Pressure Independent Variable Air Volume Digital Controllers, as shown in the drawings. The VAV ASC shall be a single integrated package consisting of a microprocessor, power supply, damper actuator, differential pressure transducer, field terminations, and application software. An alternate model shall be offered that allows for direct connectivity to an external actuator for those applications that employ a non-butterfly style damper configuration. All input/output signals shall be directly hardwired to the VAV ASC controller. The internal actuator shall employ a manual override that allows for powered or non-powered adjustment of the damper position. In all cases, the controller shall automatically resume proper operation following the return of power to, or control by the ASC. Programming, configuring and/or troubleshooting of input/output signals shall be easily executed through the ASC sensor or GP tool connected at the wall sensor location.

1. LonMark™ VAV profiles for including support for all mandatory and optional LonMark™ Standard Network Variable Types (SNVTs) as documented by the LonMark™ Interoperability Association
2. The VAV ASC control algorithms shall be designed to limit the frequency of damper repositioning, to assure a minimum 10-year life from all components. The VAV ASC shall provide internal differential pressure transducer for pressure independent applications with an accuracy of $\pm 5\%$. Flow through transducers requiring filter maintenance are not acceptable. The VAV ASC shall provide zone control accuracy equal to or better than $\pm 1^\circ\text{F}$. Systems providing control accuracies greater than $\pm 1^\circ\text{F}$ are not acceptable. With the submittal package, contractor shall provide performance data that verifies control accuracy of the VAV ASC.
3. All input/output signals shall be directly hardwired to the VAV ASC. A minimum of one input point of the VAV ASC shall employ a universal configuration that allows for flexibility in application ranging from dry contact, resistive, to voltage/current sourced inputs. If a universal point is not available, a minimum of one input point (each) of the dry contact, resistive and analog voltage/current types must be provided on every controller. The outputs of the ASC shall be of the relay and universal analog form. All digital outputs shall be relay type. ASC devices utilizing non-relay outputs shall provide an interface relay for all points. All analog outputs shall be programmable for their start points and span to accommodate the control devices. Configuration of all I/O points shall be accomplished without physical hardware jumpers, switches or settings. Troubleshooting of input/output signals shall be easily executed with the Graphical Programming tool or a volt-ohm meter (VOM). All I/O points shall be utilized by the local ASC or shall be available as I/O points for other controllers throughout the network.
4. The FMCS contractor shall provide VAV ASC to the VAV box manufacturer, for factory mounting. The VAV terminal unit supplier shall include in its price all costs for mounting of VAV ASC controller, connection of actuator to damper shaft, wiring of device power, wiring of VAV ASC to fan (fan powered terminal) and wiring to electric reheat coils or reheat valve actuator as specified on drawing.
5. The VAV terminal manufacturer shall provide a multi-point, averaging, differential pressure sensor mounted on the inlet to each VAV box. The VAV terminal unit manufacturer shall supply a line to low voltage transformer, of sufficient capacity, to power the VAV ASC plus all reheat valves and/or contactors and fan circuits associated with the VAV terminal and actuator assemblies. The FMCS contractor shall provide all reheat control valves to the mechanical contractor for mounting and piping. The FMCS contractor shall provide and install all wiring between the valve and VAV ASC controller and between the room sensor and the VAV ASC controller.

6. A minimum of two input points of the VAV ASC shall employ a universal configuration that allows for flexibility in application ranging from dry contact, resistive, to voltage/current sourced inputs. If these universal points are not available, a minimum of two input point (each) of the dry contact, resistive and analog voltage/current types must be provided on every controller.
7. Power fail Protection - All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming.

N. VAV Box Room Sensor

1. The VAV Box Room Sensor shall provide room temperature value and humidity to the controller.
2. The VAV Box Room Sensor shall connect directly to the controller Box and shall not utilize any of the I/O points of the controller.
3. The VAV Box Room Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive.
4. There shall be one VAV Box Room Sensor per floor wired so that the communication jack will provide for a connection to the LON communication trunk to which the VAV controller is connected.
5. By connecting to this VAV Box Room Sensor, the connected controller, and all other devices on the LON bus shall be accessible by the Portable Engineering Station.
6. The VAV Box Room Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering.
7. The VAV Box Room Sensor shall allow for the customization of the color on the esthetic covering as a standard offering.
8. The VAV Box Room Sensor shall be supplied in the following manner:
 - a. LCD display for viewing up to four possible displays, each showing a current value in the VAV Box or on the network.
 - b. Tenant override to allow timed override of unoccupied to occupied mode of operation.
 - c. LED indication of override state
 - d. Icons shall be utilized to represent sensor and controller function status, affording independence from a single language for use interface.
 - e. User interface with the VAV Box Room Sensor shall be provided as a configurable function, and shall offer password protection for access to network variable editing.
 - f. Six buttons to provide the following functions:
 - 1) Selection and adjustment of up to four setpoints (Setpoint Key)
 - 2) Selection of up to two HVAC modes (Mode Key)
 - 3) Selection of up to two fan modes (Fan Key)
 - g. ASHRAE 95 compliance (LCD display and sub-base functionality)
 - h. Power fail Protection - All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming.
 - i. The VAV Box Room Sensor shall provide access to additional diagnostic data from a sensor-user keypad request. This Diagnostic mode is displayed on the LCD screens and includes separate displays for the controllers:
 - 1) Subnet and Node Address
 - 2) Errors
 - 3) Alarms
 - 4) Temperature Offset

O. ASC VAV –Air Balancing.

Through the Portable Engineering Station, the VAV ASC shall support a fully prompted Air Balance sequence. The Portable Engineering Station shall, when connected through the wall sensor, access the connected VAV ASC unit. The air balance sequence shall step the balancing contractor through the checkout and calibration of the VAV ASC. Upon completion of the balancing sequence, the flow values presented by the VAV ASC shall match those observed by the balancing contractor's measurement equipment. Additionally, upon completion of the air balance, the balance settings shall be archived for future use if the controller were to require replacement. Systems not able to provide a formatted air balance Graphical Programming Tool shall provide an individual full time during the Air- balancing process to assure full balance compliance.

P. ASC – Fan Coil Unit, Unit Ventilator, Heat Pump, or Packaged Rooftop Controller Functionality.

Controls shall be microprocessor based as shown in the drawings or indicated in the sequence of operations. The ASC shall be a single integrated package consisting of a microprocessor, power supply, field terminations, and application software. The units shall be started and stopped from the BMS. A low limit protection thermostat in the mixed air section of the unit shall close down the outdoor air damper, open coil valves, and alarm the BMS when a temperature below 38°F (adjustable) is sensed. All input/output signals shall be directly hardwired to the ASC controller. In all cases, the controller shall automatically resume proper operation following the return of power to, or control by the ASC.

1. All ASCs must have an operating temperature range -40°F to 140°F and 5 to 95% RH, non condensing, because they are located in the proximity of extreme temperatures (hot water or the outdoor air).
2. All ASCs shall have capability for both ASHRAE Cycle II and ASHRAE Cycle III fully tested and validated. Bidder shall provide application documentation for ASC ASHRAE cycle II and III compliance including sequence of operation, controller program, and available SNVT's. The control program shall also be fully customizable in the field to accommodate any local or project specific requirements that may be required.
3. All duct averaging sensors for ASCs must be true continuous averaging units that sense the mean temperature over the complete length of the sensor end to end. Sensors that provide four or nine sensing points, which may be accurate due to air temperature stratifications, are not acceptable.
4. All ASCs shall be easily replaceable for ease of future maintenance and to minimize downtime.
5. Power fail Protection - All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming.
6. The outputs of the ASC shall be of the relay Form C and universal analog form. All digital outputs shall be relay type Form C. ASC devices utilizing non-relay outputs shall provide an interface relay for all points. All analog outputs shall be programmable for their start points and span to accommodate the control devices.

Q. LANs:

Capacity for a minimum of 64 client workstations connected to multiuser, multitasking environment with concurrent capability to access DDC network or control units.

1. Enterprise Network LAN

- a. Media: Ethernet (IEEE 802.3), peer-to-peer CSMA/CD, operating at 10 or 100 Mbps, cable 10 Base-T, UTP-8 wire, category 5
 - 2. Primary Controller Network LAN
 - a. Media: LonTalk™ (EIA 709.1), peer to peer, FTT-10 operating at 78.8K.
 - 3. Secondary Network LAN (If Required)
 - a. Media: LonTalk™ (EIA 709.1), peer to peer, FTT-10 operating at 78.8K
 - 4. Remote Connection
 - a. ISDN, ADSL, T1 or dial-up connection, monthly charges paid by building owner
- R. Software:
- 1. Controller and System HVAC Applications
 - a. Update to latest version of software at Project completion. Include and implement the following capabilities from the control units if documented by the specified sequence of operations:
 - 1) Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, occupied/unoccupied setback/setup, DDC with PID, and trend logging.
 - 2) HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy/economizer switchover.
 - 3) Programming Application Features: Include trend point, alarm reporting, alarm lockout, weekly scheduling, staggered start, sequencing, anti-short cycling and calculated point.
 - 2. Controller and Network Setup Software
 - a. Network managements tools for LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-1995, BACnet protocol shall be provided including a network learn function, LonMark bindings, service pins, winks, and diagnostics.

2.3 CONTROL PANELS

- A. Local Control Panels: Unitized NEMA 1 cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
- B. Fabricate panels of 0.06-inch thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
- C. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
- D. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.
- E. Provide ON/OFF power switch with over-current protection for control power sources to each local panel

2.4 SENSORS

- A. Electronic Temperature Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Resistance Temperature Detectors: Platinum, thermistor, or balco
 1. Accuracy: Plus or minus 0.2 percent at calibration point; thermistors shall have a maximum 5 year drift of no more than .225°F maximum error of no more than .36°F
 2. Wire: Twisted, shielded-pair cable
 3. Insertion Elements in Ducts: Single point, 6 inches long; use where not affected by temperature stratification or where ducts are smaller than 4 sq. ft.
 4. Averaging Elements in Ducts: 60 inches, long, flexible for use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; 264 inches long, flexible for use where prone to temperature stratification or where ducts are larger than 16 sq. ft; length as required.
 5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 6. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight with weatherproof boxes.
 7. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. Humidity Sensors: Bulk polymer sensor element.
 1. Accuracy: 2 percent at 10-90% RH with linear output.
 2. Room Sensors: Range of 0 to 100 percent relative humidity
 3. Duct and Outside-Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- D. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 1. Accuracy: $\pm 1\%$ of full scale with repeatability of 0.5 %.
 2. Output: 4 to 20 mA, 0-5 vDC, 0-10 vDC.
 3. Building Static-Pressure Range: -.1 to .1, -0.25 to 0.25, -.5 to .5, -1.0 to 1.0 IN WC., jumper selectable.
 4. Duct Static-Pressure Range: 0 to 1, 0 to 2.5, 0 to 5, 0 to 10 IN WC., jumper adjustable
- E. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; proportional output 4 to 20 mA.
- F. Equipment operation sensors as follows:
 1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 IN WC
 2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig.
 3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- G. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Carbon-Monoxide Detectors: Single or multichannel, dual-level detectors, using solid-state sensors with 3-year minimum life, maximum 15-minute sensor replacement, suitable over a

temperature range of 23°F to 130°F, calibrated for 50 and 100 ppm, with maximum 120- second response time to 100-ppm carbon monoxide.

- I. Carbon-Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over a temperature range of 23°F to 130°F, calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.
- J. Refrigerant Detectors: Dual-level detectors, using solid-state sensors, with alarm preset for 300 ppm, alarm indicator light, alarm silence light and button, alarm test light and button, and trouble light. Provide auxiliary relay preset for 150 ppm.
- K. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180°F field of view with vertical sensing adjustment, for flush mounting.

2.5 THERMOSTATS

- A. Room Temperature Sensors with Integral Display
 - 1. Room sensors shall be constructed for either surface or wall box mounting.
 - 2. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:
 - 3. Display room and outside air temperatures.
 - 4. Display and adjust room comfort setpoint.
 - 5. Display and adjust fan operation status.
 - 6. Timed override request push button with LED status for activation of after-hours operation.
 - 7. Display controller mode.
 - 8. Password selectable adjustment of setpoint and override modes.
- B. Line-Voltage, On-Off Thermostats:
 - 1. Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
 - 2. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break ungrounded conductors.
 - 3. Dead Band: Maximum 2°F.
- C. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.
 - 1. Bulbs in water lines with separate wells of same material as bulb.
 - 2. Bulbs in air ducts with flanges and shields.
 - 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.
 - 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 - 5. On-Off Thermostat: With precision snap switches, with electrical ratings required by application.
 - 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- D. Fire-Protection Thermostats: UL listed with fixed or adjustable settings to operate at not less than 75°F above normal maximum operating temperature, with the following:

1. Reset: Manual with control circuit arranged to directly shutdown appropriate equipment and provide remote annunciation at the GUI
- E. Room Thermostat Cover Construction:
 1. Set-Point Adjustment: Concealed or exposed
 2. Set-Point Indication: Concealed or exposed
 3. Thermometer: Optional
 4. Color: Neutral
 5. Orientation: Vertical or horizontal
- F. Room thermostat accessories include the following:
 1. Insulating Bases: For thermostats located on exterior walls.
 2. Thermostat Guards: As specified in tamper prone areas
 3. Adjusting Key: As required for calibration and cover screws.
 4. Set-Point Adjustment: 1/2-inch diameter, adjustment knob.
- G. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
 1. Bulb Length: Minimum 20 feet
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- H. Electric High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
 1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- I. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig., and cast housing with position indicator and adjusting knob.

2.6 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action under all environmental conditions (temperature, low power voltage fluctuations, tight seal damper design, maximum air and water flow forces).
 1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 3. Spring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running and breakaway torque of 150 in. x lbf.
 4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

- B. Electronic Damper and Valve Actuators: Direct-coupled type non hydraulic designed for minimum 100,000 full-stroke cycles at rated torque. The actuator shall have rating of not less than twice the thrust needed for actual operation of the damper or valve.
 - 1. Coupling: V-bolt and V-shaped, toothed cradle.
 - 2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 - 3. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
 - 4. Actuators shall have the ability to be tandem mounted.
 - 5. All spring-return actuators shall have a manual override. Complete manual override shall take no more than 10 turns.
 - 6. Power Requirements (Two-Position Spring Return): 24V ac or dc, Maximum 10VA.
 - 7. Power Requirements (Modulating): Maximum 15 VA at 24V ac.
 - 8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 - 9. Temperature Rating: -22°F to 140°F.
 - 10. Run Time: 200 seconds open, 40 seconds closed.
 - 11. All actuators shall have a 5 year warranty
 - 12. Valves:
 - a. Size for torque required for valve close-off at maximum pump differential pressure (regardless of water loop system pressures).
 - b. Valve and Actuators shall come from the factory fully assembled.
 - c. Spring Return Manual Override shall come with a 10° Valve Preload to assure tight close off.
 - 13. Dampers:
 - a. Size for running torque calculated as follows:
 - 1) Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. of damper.
 - 2) Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.
 - 3) Parallel-Blade Damper without Edge Seals: 4 inch-pounds/sq. ft. damper.
 - 4) Opposed-Blade Damper without Edge Seals: 3 inch-pounds/sq. ft. of damper.
 - 5) Dampers with 2 to 3 Inches wg. of Pressure Drop or Face Velocities of 1000 to 2500 FPM Multiply the minimum full-stroke cycles above by 1.5.
 - 6) Dampers with 3 to 4 Inches wg. of Pressure Drop or Face Velocities of 2500 to 3000 FPM Multiply the minimum full-stroke cycles above by 2.0.
 - b. Spring Return Manual Override actuators shall a factory set 5° Damper Preload.

2.7 CONTROL VALVES

- A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system and or dead head of the pump, unless otherwise indicated.
- B. Globe Valves NPS 2” and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity re-packable under pressure. Valves shall have allowable media temperature of 20°F to 281°F to assure that the valve packing will have a long life (valves will narrower allowable media temperatures have no reserve packing capability for long term watertight seal).
- C. Globe Valves NPS 2-1/2” and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.

- D. Hydronic system globe valves shall have the following characteristics:
 - 1. Rating: Class 125 for service at 125 psig. and 250°F operating conditions.
 - 2. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
 - 3. Sizing: 3 psig. maximum pressure drop at design flow rate.
 - 4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.

- E. Butterfly Valves: 200 psig. maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
 - 1. Body Style: Wafer, Lug, or Groove
 - 2. Disc Type: Nickel-plated ductile iron, Aluminum bronze, Elastomer-coated ductile iron, Epoxy-coated ductile iron.
 - 3. Sizing: 1 psig. maximum pressure drop at design flow rate.

- F. Terminal Unit Control Valves: Bronze body, bronze trim, two- or three-port as indicated, replaceable plugs and seats, union and threaded ends.
 - 1. Rating: Class 125 for service at 125 psig. and 250°F operating conditions.
 - 2. Sizing: 3 psig. maximum pressure drop at design flow rate, to close against pump shutoff head.
 - 3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

2.8 DAMPERS

- A. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the drawings.

- B. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.

- C. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.

- D. Damper frames and blades shall be constructed of aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Damper widths from 12" to 60" wide shall not leak any greater than 8 CFM sq. ft. @ 4" w.g. and a maximum of 3 CFM sq. ft. @ 1" w.g. static pressure when tested in accordance with AMCA Std. 500.

- E. Construction shall be airfoil blade dampers of double skin construction with linkage out of the air stream. This shall be used up to but no more than 4000 FPM or 6" w.g. Acceptable manufacturers are Ruskin CD50 or approved equal.
- F. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that duct, pipe, and equipment mounted devices and wiring are installed before proceeding with installation.

3.2 INSTALLATION

- A. Install equipment level and plumb.
- B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve sequence of operation specified.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 60 inches above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- E. Install guards or tamper proof enclosures on thermostats in the following locations:
 - 1. Entrances.
 - 2. Public areas.
 - 3. Where indicated.
- F. Install automatic dampers according to Section 23 3200 – Sheet Metal Accessories.
- G. Install damper actuators on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- H. Install labels and nameplates to identify control components according to Section 22 0553 - Mechanical Identification
- I. Install hydronic instrument wells, valves, and other accessories according to Section 23 0516 – Piping and Fittings.
- J. Install condensate instrument wells, valves, and other accessories according to Section 23 0516 – Piping and Fittings.

- K. Install duct volume-control dampers according to Section 23 3200 – Sheet Metal Accessories.
- L. Install electronic and fiber-optic cables according to Division 26.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings and/or under Division 26-Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
- B. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
- C. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
- D. Class 2 Wiring
 1. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
 2. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
 3. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduits at the panel terminations. Avoid grounding loops.
- E. BMS Line Voltage Power Source
 1. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers. Only the panel boards are provided by Division 26.
 2. Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.
 3. DDC terminal unit controllers may use AC power from motor power circuits.
- F. BMS Raceway
 1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit shall be size 1/2".
Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
 2. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
 3. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
- G. Penetrations
 1. Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.

2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
 3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
 4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.
- H. Install signal and communication cable according to Division 26.
1. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 2. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 3. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
- I. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- J. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 BMS IDENTIFICATION STANDARDS

- A. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

3.5 BMS PANEL INSTALLATION

- A. Input Devices
1. All Input devices shall be installed per the manufacturer recommendation
 2. Locate components of the BMS in accessible local control panels wherever possible.

3.6 HVAC INPUT DEVICES - GENERAL

- A. All Input devices shall be installed per the manufacturer recommendation
- B. Locate components of the BMS in accessible local control panels wherever possible.
- C. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
- D. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
- E. Outside Air Sensors

1. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
2. Sensors shall be installed with a rain proof, perforated cover.

F. Duct Temperature Sensors:

1. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
2. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
3. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
4. The sensor shall be mounted to suitable supports using factory approved element holders.

G. Space Sensors:

1. Shall be mounted per ADA requirements.
2. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.

H. Low Temperature Limit Switches:

1. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
2. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.

I. HVAC Output Devices

1. All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, air-flow stations, pressure wells, etc.
2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot petitioners shall be installed to allow for proper sequencing.
3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI.
5. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an in- put (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
1. Install piping adjacent to machine to allow service and maintenance.
- B. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.8 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. Report results in writing.
 1. Leak Test: After installation, fill system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
 4. Pressure test control for air piping:
 - a. Pressure test control air piping at 30 psig. or 1.5 times the operating pressure for 24 hours, with maximum 5 psig. loss.
 - b. Pressure test high-pressure control air piping at 150 psig. and low-pressure control air piping at 30 psig. for 2 hours, with maximum 1 psig
 5. Calibration and test both pneumatic and electric/electronic thermostats by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Replace damaged or malfunctioning controls and equipment.
 1. Start, test, and adjust control systems.
 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.
- C. COMMISSIONING
 1. Fully commission all aspects of the Building Management System work. BAS contractor shall assist and work with all trades including but not limited to the commissioning agent (or provider) to properly commission and record the BAS system.
 2. Acceptance Check Sheet
 - a. Prepare a check sheet that includes all points for all functions of the BMS as indicated on the point list included in this specification.
 - b. Submit the check sheet to the Engineer for approval
 - c. The Engineer will use the check sheet as the basis for acceptance with the BMS Contractor.
 3. VAV box performance verification and documentation:
 - a. The BMS Contractor shall test each VAV box for operation and correct flow. At each step, after a settling time, box air flows and damper positions will be sampled. Following the tests, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation or Maximum flow not achieved. The report shall be submitted as documentation of the installation.
 - b. The BMS Contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the

count of conforming and non-conforming boxes, list the nonconforming boxes along with their performance data, and shall also include graphical representations of performance.

4. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

D. Verify DDC as follows:

1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
2. Verify operation of operator workstation.
3. Verify local control units including self-diagnostics.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 40 hours' dedicated instructor time on-site.
3. Review data in maintenance manuals. Refer to Division 01-Closeout Procedures
4. Review data in maintenance manuals. Refer to Division 01-Operation and Maintenance Data.
5. Schedule training with Owner, through Architect, with at least seven days' advance notice.

3.10 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

3.11 TRAINING

A. Provide a minimum of 80 hours of on-site or classroom training throughout the contract period for personnel designated by the Owner. Each session shall be a minimum of four hours in length and must be coordinated with the building Owner. Train the designated staff of Owners Representative and Owner to enable them to:

1. Proficiently operate the system
2. Understand control system architecture and configuration
3. Understand DDC system components
4. Understand system operation, including DDC system control and optimizing routines (algorithms)
5. Operate the workstation and peripherals
6. Log on and off the system
7. Access graphics, point reports, and logs
8. Adjust and change system set points, time schedules, and holiday schedules
9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals

10. Understand system drawings, and Operation and Maintenance manual
11. Understand the job layout and location of control components
12. Access data from DDC controllers
13. Operate portable operators terminals

END OF SECTION 23-09-00

Facility Natural-Gas Piping

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
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SECTION 23 11 23 – FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Natural Gas Piping, Fittings and Accessories

1.2 REFERENCES

- A. International Code Council - ICC:
 - 1. IFGC – International Fuel Gas Code.
- B. National Fire Protection Association – NFPA
 - 1. NFPA 54 – National Fuel Gas Code

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit replacement part numbers and availability.

PART 2 PRODUCTS

2.1 Materials

- A. Piping shall be standard weight black steel pipe with 150 psi malleable iron fittings or welded as accepted by authority having jurisdiction.
- B. Valves shall be plug cocks and shall be acceptable to the authorities having jurisdiction.
- C. Valves and fittings shall be in accordance with IFGC.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Connect to the metering station and provide all downstream pipe and appurtenances.
- B. All piping up to and including the meter and incoming service pressure reducing station is by local utility company.

- C. Supply and install pressure reducing valve, with relief pipes to atmosphere, in Boiler Room.
- D. Weld all distribution piping within the building, and utilize screwed and/or flanged fittings at equipment only.
- E. Paint all gas piping in its entirety in an approved color in accordance with the Code.
- F. Provide thermal expansion control for gas piping on the roof as required by IFGC.
- G. Provide normally closed electronically operated solenoid valve (s) in the incoming natural gas distribution pipe upstream of all natural gas fired boilers. Valve assembly shall include one or more valves as required to suit service size with no appreciable pressure drop and isolation and lockable bypass valve for emergency operation.
 - 1. Installation shall be complete with push/pull emergency stop switch with red mushroom operator with normally closed contact wired in series with solenoid valve. Solenoid valve shall be powered by emergency power where available. Depression of mushroom operator shall interrupt power to the solenoid valve until manually reset. Mushroom operator shall be located at the boiler room entrance. Where entrance is not enclosed to the elements, the mushroom operator may be located on the inside at the door where it may be depressed without complete entry into the room. Provide all interconnected wiring as required for a complete and operational system.

END OF SECTION 23-11-23

Hydronic Piping Specialties

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SECTION 23 21 13 – HYDRONIC PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air and dirt separators
- B. Expansion tanks
- C. Pump accessories

1.2 RELATED SECTIONS

- A. Requirements of Section 01 including, but not limited to, General Requirements, Submittal Procedures, Quality Requirements, Product Requirements, Substitution Procedures, Operation and Maintenance Data, Demonstration and Training shall apply to all work under this section.
- B. Section 23 0516 – Piping & Fittings

1.3 REFERENCES

- A. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers; 2004.

1.4 SUBMITTALS

- A. Refer to Section 01 Submittal Procedures, for additional provisions.
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.
- C. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.
- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- E. Project Record Documents: Record actual locations of flow controls.
- F. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping components from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 MAINTENANCE SERVICE

- A. Contractor to furnish service and maintenance for one year from date of substantial completion.

1.8 EXTRA MATERIALS

- A. Refer to Section 01 - Quality Requirements, for additional provisions.

PART 2 PRODUCTS

2.1 ASME Full Bladder Type EXPANSION TANKS

- A. Manufacturers:
 - 1. Taco, Inc;
 - 2. ITT Bell & Gossett
 - 3. Armstrong
 - 4. Amtrol
 - 5. Wessels
- B. Construction: Welded steel, designed, tested and stamped in accordance with ASME (BPV code sec VIII, div 1); supplied with National Board Form U-1, rated for working pressure of 150 psi, with flexible heavy duty butyl rubber bladder. Bladder shall be able to accept the full volume of the expansion tank and shall be removable and replaceable. Bladder shall be NSF 61 rated for potable water service and shall be manufactured with FDA approved materials.
- C. Accessories: Pressure gage (field installed by others) and air-charging fitting;
- D. Automatic Cold Water Fill Assembly (field installed by others): Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.
- E. Provide an expansion tank(s) for each of the domestic water systems.

2.2 AIR and DIRT SEPARATORS

- A. Manufacturers:
 - 1. Taco, Inc;
 - 2. Spirotherm.

3. Wessels

- B. Air and dirt removal device shall be constructed of steel. It shall be designed, fabricated and stamped per ASME Section VIII Division 1 with a maximum working pressure of 250 psi at 270°F and condenser water shall be 125 psi at 270°F. Manufacturer shall be holder of ASME U stamp.
- C. Units up to three 3-inch in size shall be provided with threaded connections as standard. Units four 4-inch and larger shall be provided with flanged system connections as standard. Inlet and outlet connections to be inline with piping system. Both inlet and outlet to be in the same horizontal and vertical planes.
- D. Each air and dirt removal device shall be equipped with a brass conical shaped air venting chamber designed to minimize system fluid from fouling the venting assembly. The air vent shall be able to be closed to allow flushing and purging of dirt via side port without dirt passing through vent on initial system fill.
- E. A brass flushing cock shall be located on the side of each separator to facilitate system fast- fill and removal of the floating impurities from the air system interface within the separator.
- F. A blow down valve shall be provided by the unit manufacturer on the bottom of each unit to allow blow down and cleaning. On units 2 ½” and smaller the valve and all of its fittings shall be 1”. On units three 3” and larger the valve and all openings shall be 2”.
- G. The air and dirt removal device shall remove air down to 18 microns and shall remove dirt/debris down to 35 microns. The unit shall be 100% efficient at removing dirt down to 90 microns in 100 passes or less.
- H. The unit manufacturer shall provide the owner and design engineer third party independent test data certifying that their unit performs to the above standards. Suppliers not providing these independent performance test results will not be acceptable.
- I. The air and dirt separator shall employ the use of high surface area pall rings to achieve optimal separation of air and dirt with minimal pressure drop. The pall rings shall be made of stainless steel. Stainless steel will be the only acceptable material used for suppressing turbulence and increasing surface area for high efficiency air and dirt removal. Inferior materials of construction such as copper for the straining medium will not be acceptable.
- J. Manufacturer must have at least 15 years of experience with micro bubble coalescing and dirt removal technology.
- K. The unit shall be manufactured with a removable cover to facilitate removal, inspection, and cleaning of the pall ring basket. The entire pall ring basket shall be constructed of stainless steel. For safety and ease of service the unit shall be accessed from the top and the pall ring basket shall be accessed as one complete assembly housed in a stainless steel cage.

2.3 PUMP ACCESSORIES

- A. Pump inlet guide fitting: All pump suction to be fitted with a multifunction inlet suction diffuser. The suction diffuser body and cover plate shall be ductile iron and be rated for 250 psi for all jobs. The guide flanges shall be matched to suit the working pressure of the piping components on the job; with either ANSI class 125 flanges or ANSI class 250 flanges. The suction guide shall include the following components; full length S.S. straightening vanes, permanent S.S. strainer, disposable 16 mesh bronze start up strainer, blow down ports, and metering ports. For those pumps where an inlet guide fitting is not installed, there should be five pipe diameters of straight undisturbed flow going into the pump suction. The fitting shall be a Taco model SD inlet suction elbow or Armstrong.

2.4 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- C. Provide manual air vents at system high points and as indicated.
- D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- E. Air separator and expansion tank to be installed on the suction side of the system pumps. Expansion tank to be tied into system piping in close proximity to air separator and system fill line. The dirt separator for the condenser shall be installed on the discharge side of the pumps.
- F. Provide drain valve and hose connection on strainer blow down connection.
- G. Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.
- H. Support pump fittings with floor mounted pipe and flange supports.
- I. Provide radiator valves on water inlet to terminal heating units such as radiation, unit heaters, and fan coil units.
- J. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
- K. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- L. Pipe relief valve outlet to nearest floor drain.
- M. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

END OF SECTION 23-21-16

Refrigerant Piping

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SECTION 23 23 00 – REFRIGERANT PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Refrigerant piping.
2. Unions, flanges, and couplings.
3. Pipe hangers and supports.
4. Refrigerant moisture and liquid indicators.
5. Valves.
6. Refrigerant strainers.
7. Refrigerant pressure regulators.
8. Refrigerant pressure relief valves.
9. Refrigerant filter-driers.
10. Refrigerant solenoid valves.
11. Refrigerant expansion valves.
12. Electronic expansion valves.
13. Refrigerant receivers.
14. Underground pipe markers.
15. Bedding and cover materials.

B. Related Sections:

1. Section 05 12 00 - Structural Steel Framing: Product requirements for touch-up painting of structural steel.
2. Section 05 21 00 - Steel Joist Framing: Product requirements for touch-up painting of steel joists.
3. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
4. Section 08 31 13 - Access Doors and Frames: Access doors for concealed valves and accessories.
5. Section 09 90 00 - Painting and Coating: Product requirements for painting for placement by this section.
6. Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment: Piping materials for refrigerant systems.
7. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports, sleeves, and firestopping for placement by this section.
8. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
9. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for pipe identification for placement by this section.
10. Section 23 07 00 - HVAC Insulation: Product requirements for Piping Insulation for placement by this section.
11. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.
12. Section 31 05 13 - Soils for Earthwork: Soils for backfill in trenches.

13. Section 31 05 16 - Aggregates for Earthwork: Aggregate for backfill in trenches.
14. Section 31 23 17 - Trenching: Execution requirements for trenching required by this section.
15. Section 31 23 23 - Fill: Execution requirements for backfilling required by this section.

1.2 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 1. ARI 495 - Refrigerant Liquid Receivers.
 2. ARI 710 - Liquid-Line Driers.
 3. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Dryers.
 4. ARI 750 - Thermostatic Refrigerant Expansion Valves.
 5. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. American Society of Mechanical Engineers:
 1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 3. ASME B31.5 - Refrigeration Piping.
- D. ASTM International:
 1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 4. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
 5. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 6. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 7. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
- E. American Welding Society:
 1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- G. Underwriters Laboratories Inc.:
 1. UL 429 - Electrically Operated Valves.

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.
- C. Provide pipe hangers and supports in accordance with ASME B31.5.
- D. Flexible Connectors: Use at or near compressors where piping configuration does not absorb vibration.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.
- C. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 - 4. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:
 - a. Refrigerant moisture and liquid indicators.
 - b. Refrigerant strainers.
 - c. Refrigerant pressure regulators.
 - d. Refrigerant pressure relief valves.
 - e. Refrigerant filter-driers.
 - f. Refrigerant solenoid valves.
 - g. Refrigerant expansion valves.
 - h. Electronic expansion valves.
- D. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Test Reports: Indicate results of refrigerant leak test
- F. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.
- G. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- H. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves, equipment and refrigerant accessories.
- C. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.5 code for installation of refrigerant piping systems.
- B. Perform Work in accordance with applicable code for welding hanger and support attachments to building structure.
- C. Perform Work in accordance with the city of Ashland, KY standards.
- D. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years' experience.
- C. Design hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location. in State of KY.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.
- C. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not install underground piping when bedding is wet or frozen.

1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.12 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate trenching of buried piping systems.

1.13 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for valves excluding packing.

1.14 MAINTENANCE MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two refrigerant oil test kits each containing everything required for conducting one test.

1.15 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two packing kits for each size and valve type.
- C. Furnish two refrigerant filter-dryer cartridges of each type.

PART 2 PRODUCTS

2.1 REFRIGERANT PIPING

- A. Copper Tubing: ASTM B280, drawn.
 - 1. Fittings: ASME B16.22 wrought copper.

2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F (640 to 805 degrees C).

2.2 UNIONS, FLANGES, AND COUPLINGS

- A. 2 inches (50 mm) and Smaller:
 1. Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
 2. Copper Pipe: Bronze, soldered joints.
- B. 2-1/2 inches (65 mm) and Larger:
 1. Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
 2. Copper Piping: Bronze.
 3. Gaskets: 1/16 inch (1.6 mm) thick preformed neoprene.
- C. Grooved and Shouldered Pipe End Couplings:
 1. Housing Clamps: Malleable iron galvanized to engage and lock designed to permit some angular deflection, contraction, and expansion.
 2. Sealing Gasket: C-shape elastomer composition for operating temperature range from -30F degrees to 230F degrees .
 3. Accessories: Steel bolts, nuts, and washers.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.3 PIPE HANGERS AND SUPPORTS

- A. Conform to ASME B31.5
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 40 mm): Malleable iron, adjustable swivel, split ring.
- C. Hangers for Cold Pipe Sizes 2 inches (50 mm) and Larger: Carbon steel, adjustable, clevis.
- D. Hangers for Hot Pipe Sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.
- E. Hangers for Hot Pipe Sizes 6 inches (150 mm) and Larger: Adjustable steel yoke, cast iron roll, double hanger.
- F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- G. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches (150 mm) and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
- H. Wall Support for Pipe Sizes 3 inches (76 mm) and Smaller: Cast iron hooks.
- I. Wall Support for Pipe Sizes 4 inches (100 mm) and Larger: Welded steel bracket and wrought steel clamp.

- J. Wall Support for Hot Pipe Sizes 6 inches (150 mm) and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
- K. Vertical Support: Steel riser clamp.
- L. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- M. Floor Support for Hot Pipe 4 inches (100 mm) and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- N. Floor Support for Hot Pipe Sizes 6 inches (150 mm) and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- O. Copper Pipe Support: Carbon steel rings, adjustable, copper plated.
- P. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- Q. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- R. Sheet Lead: ASTM B749, 2.5 lb/sq ft 0.039 inch (0.99 mm) thick.

2.4 REFRIGERANT MOISTURE AND LIQUID INDICATORS

- A. Indicators:
 - 1. Port: Double, UL listed.
 - 2. Body: Copper or brass, flared or solder ends.
 - 3. Sight glass: Color-coded paper moisture indicator with removable element cartridge and plastic cap.
 - 4. Maximum working pressure: 500 psig.
 - 5. Maximum working temperature: 200 degrees F (93 degrees C).

2.5 VALVES

- A. Diaphragm Packless Valves:
 - 1. UL listed, globe or angle pattern, forged brass body and bonnet solder or flared ends.
 - 2. Phosphor bronze and stainless steel diaphragms, rising stem and hand wheel.
 - 3. Stainless steel spring, nylon seats, disc with positive back seating.
 - 4. Maximum working pressure: 500 psig (3450 kPa).
 - 5. Maximum working temperature: 275 degrees F (135 degrees C).
- B. Packed Angle Valves:
 - 1. Forged brass or nickel-plated forged steel, solder or flared ends.
 - 2. Forged brass seal caps with copper gasket, rising stem and seat with back seating, molded stem packing.
 - 3. Maximum working pressure: 500 psig (3450 kPa).
 - 4. Maximum working temperature: 275 degrees F (135 degrees C).

- C. Ball Valves:
 - 1. Two piece forged brass body with teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals, soldered ends.
 - 2. Maximum working pressure: 500 psig (3450 kPa).
 - 3. Maximum working temperature: 300 degrees.
- D. Service Valves:
 - 1. Forged brass body with copper stubs, brass caps, removable valve core, flared or solder ends.
 - 2. Maximum working pressure: 500 psig (3450 kPa).
- E. Refrigerant Check Valves:
 - 1. Globe Type:
 - a. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc.
 - b. Maximum working pressure: 450 psig.
 - c. Maximum working temperature: 300 degrees F (149 degrees C).
 - 2. Straight Through Type:
 - a. Spring, neoprene seat.
 - b. Maximum working pressure: 500 psig (3450 kPa).
 - c. Maximum working temperature 250 degrees F.

2.6 REFRIGERANT STRAINERS

- A. Straight Line or Angle Line Type:
 - 1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass.
 - 2. Maximum working pressure: 430 psig (2960 kPa).
- B. Straight Line, Non-Cleanable Type:
 - 1. Steel shell, copper plated fittings, stainless steel wire screen.

2.7 REFRIGERANT PRESSURE REGULATORS

- A. Brass body, stainless steel diaphragm, direct acting , adjustable over 0 to 80 psig (0 to 550 kPa) range, for maximum working pressure of 450 psig (3100 kPa).

2.8 REFRIGERANT PRESSURE RELIEF VALVES

- A. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; for standard 300 psig setting; selected to ASHRAE 15.

2.9 REFRIGERANT FILTER-DRIERS

- A. Replaceable Cartridge Angle Type:
 - 1. Shell: ARI 710, UL listed, brass removable cap, for maximum working pressure of 350 psig outside diameter size connections.
 - 2. Filter Cartridge: Pleated media with integral end rings, stainless steel support, filter area.

3. Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumina.
4. Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets, desiccant.

B. Permanent Straight Through Type:

1. ARI 710, UL listed, steel shell with molded desiccant filter core, for maximum working pressure of 400 psig

2.10 REFRIGERANT SOLENOID VALVES

- A. Valve: ARI 760, pilot operated, copper or brass and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, with flared, solder, or threaded ends;. Stem designed to allow manual operation in case of coil failure.
- B. Coil Assembly: UL 429, UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.
- C. Electrical Characteristics: single phase, 60 Hz.

2.11 REFRIGERANT EXPANSION VALVES

- A. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb.
- B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F (6 degrees C) superheat. Select to avoid being undersized at full load and oversized at part load.

2.12 ELECTRONIC EXPANSION VALVES

- A. Valve:
 1. Brass bodies with flared or solder connection, needle valve with floating needle and machined seat, stepper motor drive.
 2. Electrical Characteristics: 12 VA
- B. Evaporation Control System:
 1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, pre-selection allowance for electrical defrost and hot gas bypass.
 2. Electrical Characteristics: 12 VA
- C. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.13 REFRIGERANT RECEIVERS

- A. Internal Diameter 6 inch (150 mm) and Smaller: ARI 495, UL listed, steel, brazed; 400 psig maximum pressure rating, with taps for inlet, outlet, and pressure relief valve.
- B. Internal Diameter 6 inch (150 mm) and Larger: ARI 495, welded steel, tested and stamped in accordance with ASME Section VIII: 400 psig with taps for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

2.14 UNDERGROUND PIPE MARKERS

- A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.
- B. Trace Wire: Magnetic detectable conductor, clear brightly colored plastic covering, imprinted with in large letters.

2.15 BEDDING AND COVER MATERIALS

- A. Bedding: Fill Type A1
- B. Cover: Fill Type A1
- C. Soil Backfill from Above Pipe to Finish Grade: Soil Type S1

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - INSERTS

- A. Provide inserts for placement in concrete forms.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches (100 mm) and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with ASME B31.5,.
- B. Support horizontal piping hangers as scheduled.
- C. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
- D. Place hangers within 12 inches (300 mm) of each horizontal elbow.
- E. Install hangers to allow 1-1/2 inch (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- F. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
- G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.
- H. Provide copper plated hangers and supports for copper piping.
- I. Prime coat exposed steel hangers and supports in accordance with Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.5 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Remove scale and dirt on inside of piping before assembly.
- C. Install pipe to elevation as indicated on Drawings.
- D. Place bedding material at trench bottom to provide a uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches compacted depth
- E. Install pipe on prepared bedding.

- F. Route pipe in straight line.
- G. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- H. Pipe Cover and Backfilling:
 - 1. Backfill trench in accordance with Section 31 23 23. Maintain optimum moisture content of fill material to attain required compaction density.
 - 2. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 4 inches compacted layers to 6 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 - 3. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 4. Do not use wheeled or tracked vehicles for tamping.

3.6 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Route piping parallel to building structure and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
- E. Install pipe identification in accordance with Section 23 05 53.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide access where valves and fittings are not exposed.
- H. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Flood refrigerant piping system with nitrogen when brazing.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- K. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 90 00.
- L. Install valves with stems upright or horizontal, not inverted.
- M. Insulate piping and equipment; refer to Section 23 07 00.
- N. Provide replaceable cartridge filter-dryers, with isolation valves and bypass with valve.
- O. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

- P. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- Q. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- R. Provide electrical connection to solenoid valves. Refer to Section 26 05 03.
- S. Fully charge completed system with refrigerant after testing.
- T. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
- U. Install refrigerant piping in accordance with ASME B31.5.

3.7 INSTALLATION - REFRIGERANT SPECIALTIES

- A. Refrigerant Liquid Indicators:
 - 1. Install line size liquid indicators in main liquid line downstream of condenser.
 - 2. When receiver is provided, install line size liquid indicators in liquid line downstream of receiver.
 - 3. Install line size liquid indicators downstream of liquid solenoid valves.
- B. Refrigerant Valves:
 - 1. Install service valves on compressor suction and discharge.
 - 2. Install gage taps at compressor inlet and outlet.
 - 3. Install gage taps at hot gas bypass regulators, inlet and outlet.
 - 4. Install check valves on compressor discharge.
 - 5. Install check valves on condenser liquid lines on multiple condenser systems.
 - 6. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.
- C. Strainers:
 - 1. Install line size strainer upstream of each automatic valve.
 - 2. Where multiple expansion valves with integral strainers are used, install single main liquid-line strainer.
 - 3. On steel piping systems, install strainer in suction line.
 - 4. Install shut-off valves on each side of strainer.
- D. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.
- E. Filter-Dryers:
 - 1. Install permanent filter-dryers in low temperature systems.
 - 2. Install permanent filter-dryer in systems containing hermetic compressors.
 - 3. Install replaceable cartridge filter-dryer vertically in liquid line adjacent to receivers.
 - 4. Install replaceable cartridge filter-dryer upstream of each solenoid valve.
- F. Solenoid Valves:

1. Install in liquid line of systems operating with single pump-out or pump-down compressor control.
2. Install in liquid line of single or multiple evaporator systems.
3. Install in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

3.8 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test refrigeration system with dry nitrogen to 200 psig.
- C. Repair leaks.
- D. Retest until no leaks are detected.

3.9 SCHEDULES

- A. Pipe Hanger Spacing:

| PIPE SIZE Inches | COPPER TUBING MAXIMUM HANGER SPACING Feet | STEEL PIPE MAXIMUM HANGER SPACING Feet | MINIMUM HANGER ROD DIAMETER COPPER TUBING Inches | MINIMUM HANGER ROD DIAMETER STEEL PIPE Inches |
|---------------------|--|---|--|--|
| 1/2 | 5 | 7 | 3/8 | 3/8 |
| 3/4 | 5 | 7 | 3/8 | 3/8 |
| 1 | 6 | 7 | 3/8 | 3/8 |
| 1-1/4 | 7 | 7 | 3/8 | 3/8 |
| 1-1/2 | 8 | 9 | 3/8 | 3/8 |
| 2 | 8 | 10 | 3/8 | 3/8 |
| 2-1/2 | 9 | 11 | 1/2 | 1/2 |
| 3 | 10 | 12 | 1/2 | 1/2 |

END OF SECTION 23-23-00

Metal Duct

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

SECTION 23 31 13 – METAL DUCT

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes metal, rectangular ducts and fittings for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus (-) 2.0 to plus (+) 10.0 inches w.g. Metal ducts include the following:
 - 1. Rectangular ducts and fittings.
 - 2. Double-wall, round, and flat-oval spiral-seam ducts and formed fittings.
 - 3. Duct liner.
- B. See Section 23 3200 - Sheet Metal Accessories for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
- C. See Section 23 0700 for insulation requirements.
- D. Pittsburgh seams shall be the only acceptable seam type. Button punch is not acceptable.

1.2 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for metal ducts including, but not limited to:
 - 1. Penetrations through fire-rated and other partitions.
 - 2. Duct layout indicating sizes and pressure classes.
 - 3. Elevations of top and bottom of ducts
 - 4. Dimensions of main duct runs from building grid lines
 - 5. Seam and joint construction
 - 6. Duct accessories, including access doors and panels.
 - 7. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.

1.3 1.03 QUALITY ASSURANCE

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. 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: Lock-forming quality; complying with ASTM A 653/A 653/M and having G90 (Z275) coating designation. Ductwork that is exposed to view shall have mill-phosphatized finish for enhanced paint adhesion and corrosion resistance.
- C. Stainless Sheet Steel: Lock-forming quality; complying with ASTM A 167/A 480 and having No. 2D finish- cold-rolled, dull finish; ducts shall have a No. 4 finish for surfaces exposed to view.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- E. 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.
- F. Fire-resistance-rated through penetrations: Unless otherwise noted, all ductwork penetrating fire-resistance-rated wall assemblies shall have a minimum wall thickness of 0.0187-inch (26 gauge).

2.3 SEALANT MATERIALS

- A. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.
- B. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
- C. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- D. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- E. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

- F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
 - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 - 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Galvanized-steel shapes and plates complying with ASTM A 36/A 36M.

2.5 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Ward Industries, Inc.
 - 2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Lockformer.
 - c. TDF/TDC
 - 2. Longitudinal Seams: Pittsburgh lock sealed with non-curing polymer sealant.

- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of non-braced panel area unless ducts are lined.

2.6 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Round, Longitudinal and Spiral Lock Seam Ducts: Unless otherwise noted, fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals. Use the following metal thickness for pressure classes from minus 2 to plus 10-inch w.g.:
 - 1. Ducts 3 to 16 Inches in Diameter: 24 ga.
 - 2. Ducts 17 to 48 Inches in Diameter: 22 ga.
 - 3. Ducts 49 to 84 Inches in Diameter: 20 ga.
- C. Flat-Oval, Longitudinal and Spiral Lock Seam Ducts: Unless otherwise noted, fabricate ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals. Fabricate ducts larger than 72 inches in diameter with butt-welded longitudinal seams. Use the following metal thickness for pressure classes from minus 2 to plus 10-inch w.g.:
 - 1. Ducts 3 to 16 Inches in Diameter: 24 ga.
 - 2. Ducts 17 to 48 Inches in Diameter: 22 ga.
 - 3. Ducts 49 to 84 Inches in Diameter: 20 ga.
- D. Manufacturers:
 - 1. Lindab Inc.
 - 2. McGill AirFlow Corporation
 - 3. SEMCO Incorporated
 - 4. Spiral Pipe of Texas
- E. Duct Joints:
 - 1. Ducts up to 20 inches in diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 - 2. Ducts 21 to 72 inches in diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 - 3. Ducts larger than 72 inches in diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
 - 4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
 - a. Manufacturers:
 - 1) Lindab, Inc.
 - 2) Ductmate Industries, Inc.
 - 3) WARD Industries

5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
 - a. Manufacturers:
 - 1) McGill AirFlow Corporation.
 - 2) Ductmate Industries, Inc.
 - 3) SEMCO Incorporated.
 - 4) WARD Industries
- F. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- G. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- H. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1.5 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
 2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2 to plus 10-inch w.g.:
 - a. Ducts 3 to 16 Inches in Diameter: 24 ga.
 - b. Ducts 17 to 48 Inches in Diameter: 22 ga.
 - c. Ducts 49 to 84 Inches in Diameter: 20ga.
 3. Flat-Oval Mitered elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
 4. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material- handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 5. Round elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 6. Round elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 7. Round elbows larger than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
 8. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch (20ga.) thick with 2-piece welded construction.
 9. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
 10. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.

2.7 DOUBLE-WALL DUCT AND FITTING FABRICATION

- A. Manufacturers:
 1. Lindab, Inc.

2. McGill AirFlow Corporation.
 3. SEMCO Incorporated.
- B. Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.
1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches longer than inner duct and insulation and in metal thickness specified for single-wall duct.
 2. Insulation: Refer to Section 23 07 00.
 3. Solid Inner Ducts: Use the following sheet metal thicknesses and seam construction:
 - a. Ducts 3 to 16 Inches in Diameter: 24 ga. with standard spiral-seam construction.
 - b. Ducts 17 to 48 Inches in Diameter: 22 ga. with single-rib spiral-seam construction.
 - c. Ducts 49 to 84 Inches in Diameter: 20 ga. with single-rib spiral-seam construction.
 4. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.
- C. Fittings for pressure classes from minus 2- to plus 10-inch w.g.: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.
1. Solid Inner Ducts: Use the following sheet metal thicknesses:
 - a. Ducts 3 to 16 Inches in Diameter: 24 ga.
 - b. Ducts 17 to 48 Inches in Diameter: 22 ga.
 - c. Ducts 49 to 84 Inches in Diameter: 20 ga.

PART 3 EXECUTION

3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
1. All Supply and Return Air Ducts: 3-inch w.g.
 2. Outside Air Ducts (Negative Pressure): 3-inch w.g.
 3. Exhaust Ducts (Negative Pressure): 3-inch w.g.
 4. Combustion Air Ducts: 4-inch w.g.

3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install ducts with fewest possible joints.
- C. Install fabricated fittings for changes in directions, size, and shape and for connections.
- D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of e, with a minimum of 3 screws in each coupling.
- E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- I. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- J. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- K. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- M. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Section 23 32 00 - Sheet Metal Accessories. Firestopping materials and installation methods are specified in Division 07 - Penetration Firestopping.
- N. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

3.3 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards-- Metal and Flexible" for duct pressure class indicated.
 - 1. Seal all transverse joints and seams.
- B. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 10 feet and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.

- E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Section 23 32 00 – Sheet Metal Accessories.
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 FIELD QUALITY CONTROL

- A. Leakage Tests: Conduct duct leakage test in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Repair leaks and repeat tests until total leakage is less than 3% unless otherwise noted.
- B. General
 - 1. Ductwork pressure tests shall be observed by Architect prior to installation of insulation.
 - 2. Ductwork systems constructed to 3" W.G. pressure class and higher shall be tested in their entirety for leaks.
 - 3. All new and existing supply and exhaust ductwork, excluding ductwork located within shafts, shall be leak tested. If test pressure and leakage requirements are not met, repairs and sealing shall be done with sheet metal, tape, sealant or a combination thereof. Testing shall include removal and replacement of existing duct insulation as necessary.
 - 4. Test Failures: Duct systems shall be repaired if test pressure and leakage requirements are not met or if air noise condition is encountered. Repairs and sealing shall be done with sheet metal, tape, sealant or a combination thereof.
- C. Test Equipment:
 - 1. Portable rotary type blower or tank type vacuum cleaner with control damper. Equipment shall have sufficient capacity to properly test reasonably large duct system section.
 - 2. Orifice assembly consisting of straightening vanes and calibrated orifice plate mounted in a straight tube with properly located pressure taps.
 - 3. Two (2) U-tube manometers, one to measure drop across calibrated orifice and one to measure S.P. in duct being tested. Provide low differential pressure Dwyer magnehelic gauges for low leak testing in lieu of U-tube manometers.
- D. Testing Pressures and Permissible Leakage:
 - 1. Test pressure shall be equal to the construction class. Negative pressure duct shall be tested at the equivalent positive pressure.
 - 2. Allowable leakage shall be determined from the following equation (or figure 4-1 in the above referenced Standard):
$$F = CL (P)^{0.65}$$
Where: F = Allowable leakage factor CFM/100 Sq. Ft.
CL = Leakage Class
P = Test pressure inches W.C.
 - 3. Leakage class shall be as follows:
 - a. Seal class A, Rectangular duct, CL = 6.

- b. Seal class A, Round duct, CL = 3.
- 4. Record all tests using the procedure and forms in the above referenced manual.
- 5. All plenums and casings shall be tested by pressuring to the pressure class indicated and visually observing leakage and panel deflection.
 - a. No noticeable leakage shall be allowed.
 - b. Deflection shall be less than 1/8" per foot.

3.7 INSPECTION

- A. After completion of the ductwork installation, and after the Test and Balancing work, a minimum of 10% of the installed length of the supply duct system shall be inspected by an independent company specializing in such work. Inspection shall be performed using fiber optic video equipment and other appropriate techniques.
 - 1. Sections to be inspected shall be determined by the Architect.
- B. A report, including a recording on DVD of the video shall be submitted to the Architect. The report shall document the findings of the inspection, listing any areas of concern, including evidence of water, dust, dirt and construction debris.
- C. If, in the opinion of the Architect and the Inspection company, the supply ductwork is unacceptably contaminated, the supply duct system shall be cleaned. Additional inspections shall be performed, including sections not previously inspected. This process shall be repeated until, in the opinion of the Architect, the supply duct system is acceptably clean.

END OF SECTION 23-31-13

Sheet Metal Accessories

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
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SECTION 23 32 00 – SHEET METAL ACCESSORIES

PART 1 GENERAL

1.1 PROVISIONS

- A. Requirements of Division 01 including, but not limited to, General Requirements, Submittal Procedures, Quality Requirements, Product Requirements, Substitution Procedures, Operation and Maintenance Data, Demonstration and Training shall apply to all work under this section.
- B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition.

1.2 DESCRIPTION

- A. Work covered by this Section includes furnishing of and paying for all materials, labor, services, equipment, licenses, taxes, other items, and appliances necessary for the execution, installation and completion of all work specified herein and/or shown on the drawings.
- B. The work described in this section of the specifications includes but is not limited to the following:
 - 1. Sheet metal accessories as specified herein and in locations shown on drawings, complete with all hardware necessary for a fully functional installation.

1.3 RELATED WORK

- A. The following items of related work are specified and included in other sections of these specifications:
 - 1. Section 23 0500 - Common Work for HVAC, Plumbing, and Fire Protection
 - 2. Section 23 0140 - Cleaning Mechanical Systems
 - 3. Section 23 0593 - Testing, Adjusting & Balancing
 - 4. Section 23 0700 - Mechanical Systems Insulation
 - 5. Section 23 3113 - Sheet Metal Duct

1.4 QUALITY ASSURANCE

- A. Fire dampers to be UL labeled and conform to NFPA 90A and NFPA 90B.
- B. Air diffusers, grilles, and registers to have ratings certified by Air Diffusion Council and tested per ADC Equipment Test Code 1062R2 and ASHRAE Standard 36B-63.

1.5 SUBMITTALS

- A. Submit product data to Architect for approval as required by Division 01 for all items listed in this section of the specification

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Grilles, Registers and Diffusers: Titus, Nailor, Price, or prior approved equal.
- B. Flexible Connections: Duro-Dyne, Ventfabrics, or prior approved equal.
- C. Manual Dampers: Nailor, Penn, Ruskin, Metal-Form Mfg., Greenheck or prior approved equal.
- D. Motorized Control Dampers: Nailor, Penn, Ruskin, Metal-Form Mfg., Greenheck or prior approved equal.
- E. Access Doors and Panels: Duro-Dyne, Ruskin, Milcor, Ventfabrics, or prior approved equal.
- F. Latches, Hinges: Duro-Dyne, Ventfabrics, or prior approved equal.
- G. Fire Dampers: Ruskin, Air Balance, Nailor, Phillips, Prefco, Greenheck, or prior approved equal.
- H. Turning Vanes: United Sheet Metal, Duro-Dyne, Elgin, Aero Dyne, or prior approved equal.

2.2 ACCESS DOORS

- A. Provide insulated doors in ductwork for equipment service such as automatic dampers, duct coils (each side) casing mounted coils (each side), filters (each side), duct mounted smoke detectors and elsewhere as noted on drawings.
- B. The size of all access doors shall be as follows:

| Duct Size | Access Door |
|------------------|--|
| 12" to 20" | 12" x 12" |
| 20" to 36" | 18" x 18" |
| 36" and above | 24" x 24" |
| Under 12" | Of sufficient size to service equipment or replace fusible link. |

- C. Apparatus Casing Access Doors: Prehung door frame assemblies.
- D. Access Doors, Insulated Ducts: Double thickness galvanized sheet metal of same gauge as duct (minimum 20 gauge) with minimum of 1" thick, 2-pound density fiberglass or approved equal insulation in between sheet metal, rolled edges, hinges and latch. Make airtight with felt strips or neoprene gasketing, and provide 1" x 1" galvanized angle iron frame for installation in ductwork.
- E. Mount doors in a rigid frame of at least 22 gauge formed galvanized steel or aluminum.
- F. Use angle iron bracing as required to make the door frame a rigid assembly.

- G. Hinge access doors and provide positive closing, tight sealing and easily operated latches.
- H. Provide latches that permit easy removal of access door while maintaining positive closing and minimum leakage.
- I. Provide sponge rubber gaskets for all doors.
- J. Complete insulation coverage up to the boxes.

2.3 FLEXIBLE CONNECTIONS

- A. Twenty-four ounce glass fabric that is flameproof, airtight, ozone resistant, and a minimum of 3" wide with 3" of metal on each side of 3" of fabric using a grip lock seam.

2.4 MANUAL DAMPERS

- A. Minimum of 16 gauge galvanized steel, maximum of 8" blade, opposed blade type, with manual quadrant. Damper rod and quadrant handle shall extend out a minimum of 2" so as not to interfere with or require compression of external duct wrap.

2.5 MOTORIZED CONTROL DAMPERS

- A. AMCA-rated, opposed-blade design; minimum of 0.1084 inch thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635 inch thick, galvanized-steel damper blades with maximum blade width of 8 inches.
 - 1. Secure blades to 1/2 inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 - a. Provide opposed-blade design with replaceable rubber seals. Dampers shall be rated for maximum leakage per adopted ASHRAE 90.1 Standard when tested according to AMCA Standard 500D.

2.6 MANUAL QUADRANTS

- A. On all low pressure dampers in insulated ducts and in uninsulated ducts approved.

2.7 CONCEALED DAMPER OPERATORS

- A. For inaccessible ceilings and wall installations of dampers.

2.8 ACCESS PANELS AND ACCESS OPENINGS IN DUCTWORK

- A. Galvanized, sheet steel, 2 gauges heavier than the duct with rolled edges, felt strips or neoprene gaskets and attached to duct with sheet metal screws a maximum of 6" on center.

2.9 FIRE DAMPERS

- A. Furnish and install access panels as hereinbefore described to meet the requirements of the code. All fire dampers must be constructed in accordance with Underwriters' Laboratories and city code requirements. Dampers shall be dynamic type with the damper out of the airstream for 100% free area.

2.10 FIRE SMOKE DAMPERS

- A. Furnish and install Greenheck Model FSD -211 combination Fire smoke dampers approved for installation in walls and floors, sized for the openings, rated per UL 555 and UL555Sn leakage class 1, 1 ½ hour fire rating for closure at 2000 fpm, maximum pressure 6" wg, 120 volt actuators, normally closed position - powered actuator to open. The dampers and accessories must be approved for the installation and application and the installation must comply with the UL installation requirements for that model damper. The damper and the damper installation must meet all the codes and regulatory requirements in the area where the work is done. Nailor, and Ruskin are approved manufacturers if they comply with the above requirements.

2.11 SHEET METAL TURNING VANES

- A. Factory fabricated, single thickness, galvanized sheet metal with airfoil contour. Shop fabricated duct turns must be submitted for approval prior to processing any work on project.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Sheet metal accessories to be installed in locations shown on drawings.
- B. Installation to be in accordance with manufacturer's published recommendations as well as applicable sections of the SMACNA manual.
- C. Provide all screws, bolts, nuts, inserts, and material required for attaching sheet metal to duct, walls, floors and ceilings.

3.2 CONNECTORS

- A. Ductmate, Ward, TDC and TDF connectors are allowed when fabricated and installed in strict compliance with manufacturer's instructions.

3.3 TURNING VANES

- A. Provide single thickness turning vanes in all 90 degree square elbows and elsewhere as indicated. Use acoustical turning vanes where indicated.

3.4 SEALING

- A. Seal joints, seams and other openings in duct system to seal level a, irrespective of duct construction pressure class.

3.5 DUCT SIZES

- A. Indicated sizes are to the inside of acoustical linings. Increase the size of all sheet metal ducts as required to accommodate acoustical lining.

3.6 DUCT OPENINGS

- A. Construct duct openings at grilles or registers so that the plaster will not crack when the registers are attached.

3.7 PAINTING

- A. Paint the inside of all supply, return and exhaust ducts and dampers one coat of dead black paint whenever visible through the openings. Where the duct insulation is visible through the grilles, registers, or diffusers, the insulation must have a black finish.

3.8 FLEXIBLE CONNECTIONS

- A. Provide flexible connections at the intake and discharge of all air handling and air conditioning units and elsewhere as indicated.

3.9 MEASUREMENTS

- A. Before fabrication, check all ductwork with the building construction for dimensions, locations, clearances, etc. Make up duct with any necessary variations to conform to the details of the construction of the building, to suit the space available, and to fit the equipment furnished. The entire duct system must be substantially constructed, rigidly erected and free of any duct vibration or noises.

3.10 FIRE DAMPERS

- A. Install per the manufacturer's printed instructions and per the UL listing instructions for the exact fire damper provided.

3.11 CONCEALED DAMPER OPERATORS

- A. Install per the manufacturer's printed instructions and as detailed on the drawings.

3.12 TESTING

- A. Check work for satisfactory installation and performance.
- B. Where applicable, check duct connections, access doors, etc., for leakage and condensation and correct conditions found.

END OF SECTION 23-32-00

HVAC Fans

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

SECTION 23 34 00 – HVAC FANS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Requirements of Division 01 including, but not limited to, General Requirements, Submittal Procedures, Quality Requirements, Product Requirements, Substitution Procedures, Operation and Maintenance Data, Demonstration and Training shall apply to all work under this section.

1.2 SUMMARY

- A. This Section includes the following:
 1. Centrifugal wall and roof exhaust fans.
 2. Centrifugal exhaust fans for grease laden vapors.
 3. Dryer exhaust fans.
 4. Plenum fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan performance ratings on actual Project site elevations.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and 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.
- 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.
 2. Design Calculations: Calculate requirements for selecting vibration isolators for designing vibration isolation bases.
 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
- C. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- D. Field quality-control test reports.

- E. Submit Equipment Operating and Maintenance Manuals. The following information shall be considered a minimum. Where applicable, provide information required for specific pieces of equipment.
1. Personnel familiar with the operation and maintenance of the specific information shall prepare manuals.
 2. Equipment shall be identified as shown in the Schedules and on the Drawings.
 3. Provide information in three ring binders. All sheets shall have reinforced punches. Tabbed dividers shall separate all sections. Drawings will be bound in the manual, or contained in envelopes bound into the manual.
 4. Contents - Each volume shall contain the following minimum contents:
 - a. Installation including instructions for unpacking, installing, aligning, checking and testing. Foundation data, allowable piping loads, and electrical design shall be included.
 - b. Operating Instructions to provide pre-operational checks, start up and shut down, and description of all control modes. Include emergency procedures for all fault conditions and actions to be taken for all alarms. Procedures for long term storage shall be included.
 - c. Maintenance shall include preventive, and corrective. Schedules for test of other functions are to be included. Provide a list of tools required to service the equipment. Trouble shooting instructions to include a trouble-shooting guide shall be included.
 5. Spare Parts List
 6. Shop Drawing Data to include performance curves, data sheets, flow diagrams, wiring diagrams, and descriptive drawings.
 - a. In general, corrections or comments, or lack thereof, made relative to submittals during review shall not relieve the Contractor from compliance with the requirements of the drawings and specifications. Submittals are for review of general conformance with the design concepts of the project and general compliance with the contract documents. The Contractor is responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the work of all trades, and performing the work in a safe and satisfactory manner.
 - b. Provide a recommended list of spare parts to be provided.

1.5 REFERENCE STANDARDS

- A. These standards shall be considered as minimum requirements. This is a general list and not all standards listed are necessarily referenced elsewhere in this Section. Specific requirements of this Section and/or Drawings shall have precedence. The Architect shall resolve conflicts between published requirements.
- B. Titles and abbreviation of Federal, State and industry standards, technical societies, associations and institutes and other organizations, which may be used, are as follows:
1. Air Diffusion Council (ADC)
 2. American Bearing Manufacturers Association (ABMA)
 3. Air Movement and Control Association (AMCA)
 4. American National Standards Institute (ANSI)
 5. Air Conditioning and Refrigeration Institute (ARI)
 6. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
 7. American Society of Mechanical Engineers (ASME)
 8. American Society for Testing and Materials (ASTM)

9. Factory Mutual (FM)
10. Institute of Electrical and Electronic Engineers (IEEE)
11. National Institute of Standards and Technology (NIST)
12. National Electrical Code (NEC)
13. National Electrical Manufacturers Association (NEMA)
14. National Fire Protection Association (NFPA)
15. Occupational Safety and Health Administration (OSHA)
16. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
17. Underwriters Laboratories (UL)

1.6 QUALITY ASSURANCE

- A. All equipment of a given type included in this section shall be furnished by or through a single manufacturer or as specified on the schedules.
- B. Inspection by the Architect or failure to inspect shall not relieve the Contractor of responsibility to provide materials and perform the work in accordance with the documents.
- C. The Owner and Architect reserve the right to sample and test any materials after delivery and to reject all components represented by a sample that fails to comply with the specified requirements.
- D. An authorized representative of the manufacturer shall perform the initial startup of the equipment. The Owner and Architect shall witness startup. The use of local sales representatives to perform this work is not acceptable, unless the manufacturer provides documented evidence that the sales representative has been specifically trained for this work.
- E. All rotating parts of equipment shall be statically and dynamically balanced at the factory.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. All materials shall be inspected for size, quality and quantity against approved shop drawings upon delivery.
- E. Delivery schedule of all equipment shall be coordinated with the Contractor. Equipment ready for shipment prior to the agreed on shipping date shall be stored without cost to the Owner by the manufacturer.
- F. All materials shall be suitably packed for shipment and long term storage. Each package shall be labeled to indicate the project and the contents of each package. Where applicable, equipment numbers shall be marked on the container.

- G. All equipment shipped that is exposed such as on a flat bed truck shall be protected during transit. The equipment shall be protected from moisture, road salt, dirt and stones or other materials thrown up from other vehicles. Electrical components shall be protected as above, but with special attention to moisture. The method of shipment protection shall be defined in the submittals.
- H. Instruction for the servicing and startup of equipment in long term or prolonged storage shall accompany each item.
- I. All materials shall be stored in a covered dry location off of the ground. When required to protect the materials they shall be stored in a temperature-controlled location.

1.8 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Roof penetrations requirements are specified in Division 07.

1.9 ELECTRIC MOTORS

- A. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed CEE Premium Efficiency™ full load efficiencies. The Consortium for Energy Efficiency (CEE), a national, non-profit public benefits corporation, promotes the manufacture and purchase of energy-efficient products and services.
- B. Motors shall be wound for 200, 230, 460, or 230/460 three-phase, 60-hertz, 1.15 service factor.
- C. Windings shall be copper magnet wire rated at 200° C and moisture resistant. Magnet wire insulation varnish must be of a type designed to resist transient spikes (such as Inverter Spike Resistant™ ISR), high frequencies, and short time rise pulses produced by inverters. Motor insulation system shall comply with NEMA MG1-1998 Part 31.4.4.2.
- D. Insulation shall be a Class F, non-hygroscopic varnish. The maximum permissible temperature for the insulation is not exceeded when the motor operates at service factor load in a 40°C ambient. Magnet wire shall have a service coating equivalent in thickness to a commercial "heavy" coating. The combination of magnet wire and varnish when tested in accordance with IEEE No. 57, latest revision, shall show a thermal rating of not less than 150°C for a duration of 30,000 hours life. Normal temperature rises for 1.0 service factor operation shall not exceed a Class B rise.
- E. The motor manufacturer shall confirm that motors used to power equipment are provided with bearings that will provide a bearing life equal to the driven equipment or better. Confirmation shall be included with shop drawing submittal.

- F. Electric motors enclosures in NEMA frame sizes shall conform to the following requirements, unless otherwise specified:
 - 1. Clean, Dry Areas – Open-Drip Proof (ODP)
 - 2. Outdoors – Totally Enclosed Fan Cooled (TEFC)
 - 3. Process Areas (NOT Div. 1 or 2) – TEFC
 - 4. Div. 1 or 2 Classified Areas - Explosion Proof (XP)

1.10 SPARE PARTS

- A. Spare parts shall include all special items on the manufacturer's standard list of spare parts
- B. In addition to special items, the following spare parts shall be provided:
 - 1. Furnish all special tools required for normal operation and proper servicing of the equipment.
 - 2. Spare parts shall include all items on the manufacturer's standard list of spare parts and the following for each unit:
 - a. Belts: 2 set(s) for each belt-driven unit.

PART 2 PRODUCTS

2.1 GENERAL

- A. The use of a manufacturer's name and model of catalog number is for the purpose of establishing the standard quality, grade, type, size, physical arrangement, performance characteristics and availability.
- B. Fans shall be factory assembled, complete with fan wheel, fan housing or cabinet, bearings, drives, drive guard, motor, motor base, unit base and vibration isolators, dampers and bird screens unless otherwise specified. All fans shall be provided with lugs, brackets or field supplied devices to allow the fan to be firmly bolted to the structure or fastened to specified vibration isolators. The lugs, brackets or field supplied devices shall be sized to withstand the expected seismic loads for the area and type of application. Location of the attachments shall be based on the equipment being hung or base mounted as shown on the Drawings and the schedules.
- C. All fans shall be statically and dynamically balanced prior to shipment from factory.
- D. Unless otherwise noted, all fans shall be Class 2 construction per AMCA Standard 99.
- E. Where belt drives are used, motors shall be provided with adjustable slide bases. Adjustable sheaves and slide bases shall be selected so that the midpoint of the adjustable range matches the fan schedule data. Drives selected shall have a safety factor of 1.5 times motor horsepower.
- F. All fans shall be AMCA certified for air performance and sound ratings tested in accordance with AMCA 300.
- G. Motors shall be selected to be non-overloading over the entire operating range of the equipment and for the reasonable expected temperature and humidity. A safety factor of 25 per- cent will be added to all motors up to and including 50 horsepower. A safety factor of 15 per- cent will be

added to all motors over 50 horsepower. Motors indicated in the schedules are to be considered a minimum. The schedule sizing is not to limit compliance with the above requirements.

- H. For motors operated by solid-state speed controllers, motor horsepower and disconnect shall be adjusted to prevent motor overloading conditions.
- I. Fans shall be assembled with OSHA shaft and motor guards. Provide access for greasing bearings, tachometer readings of fan and motor speed without removing the cover. Cover shall be properly ventilated to prevent motor overheating.
- J. Ductwork connections to units that require corrosion resistant coatings shall be made with flanges. Flanges shall be factory drilled before coating. Resilient washers suitable for the environment shall be used to protect the coating from the bolts in the flange. The use of self tapping screws or other fastening methods that will damage the coating are not acceptable.
- K. The noise level of the equipment operating in the field shall not exceed 85 dBA overall sound pressure level (referenced to 20 micro pascals) at a distance of 3-ft from equipment surfaces. Provide octave band sound data if another noise level is specified in the schedule or if sound data submission is specified in the schedules.
- L. Refer to Section 23 05 48 for general requirements for vibration isolators. Adhere to those requirements and the specific requirements in this Section.
- M. Provide inlet and/or outlet safety screens for fans that are not directly duct connected.
- N. Roof mounted fans shall be provided with aluminum factory fabricated insulated roof curbs. Roof curb height shall be determined based on a minimum equipment base installed height of 18 inches above finished roof level.
- O. Roof mounted fans shall be rated for 140 mph wind.

2.2 BEARINGS

- A. Grease lubricated bearings (except where driven by motors smaller than 1/2 Hp) shall be equipped with Zerk lubrication fittings and with provision for automatic relief of lubricant pressure away from fan wheel. The latter may be accomplished by either built-in relief devices or automatic ball-and-spring relief fittings at the bottom of the bearing housing.
- B. Pressure relieves shall be located outside of the units and shall be visible from maintenance locations. Lubrication fittings shall be located to be easily accessible from maintenance or operating levels. Where necessary, extension tubes shall be provided to bring the service fitting to an accessible location and the relief visible from the same location.
- C. Bearings for all equipment in the schedule below shall have heavy-duty grease lubricated ball or roller bearings. Bearings shall have ample thrust provision to prevent end play during the normal life of the bearing. Unless specifically noted otherwise, all fans shall have bearings for both the equipment and motors with the following ABMA L-10 life.
 - 1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.

- D. For systems with bearings requiring L-10 lives of 100,000 hours or greater, the equipment supplier shall provide calculations for both the equipment bearings and the motor bearings to confirm the bearing selections. For belt drives, the calculations shall include the effect of the sheave size, number of belts, the sheave location on the shaft, and the location of the motor to the driven sheave.
- E. The equipment manufacturer shall provide confirmation of the required life based on the actual drive components. For motors 50 horsepower and greater, the bearing life calculations for both the equipment bearings and the motor bearings shall be provided.
- F. When bearings are not accessible, extended supply and relief fittings shall be supplied. Both supply and relief fittings shall terminate in the same location.

2.3 FLAME AND SMOKE RATINGS

- A. All materials, including adhesives, surface coatings, sealers, assemblies of several materials, insulation, jacketing, finish, etc, shall have flame spread ratings not over 25 (fire resistive) and smoke development ratings not over 50 and fuel contributed rating not over 50, as established by tests conducted in accordance with the Federal Standard 00136B, National Bureau of Standards Radiant Energy Fire Test and the National Fire Code of the NFPA.
- B. These requirements shall apply to all circumstances whether the materials are field applied or have been applied by a manufacturer in his/her shop, or elsewhere, prior to delivery to the project for installation.

2.4 V-BELT DRIVE

- A. V-belt drives shall consist of the driver and driven sheaves and one or multiple matched V-belts. Drives furnished to transmit less than 3/4 HP may be a single groove, single belt type. Drives to transmit 3/4 HP or more shall consist of at least two belts. Belts smaller than "A" cross-section shall not be used.
- B. Each sheave shall be grooved to match the belt selection, bored and keyed to fit the receiving shaft, and grooves shall be in parallel planes exactly perpendicular to the bore for the full 360 degrees. Sheaves shall have keys and setscrews. Sheave material may be cast iron.
- C. The drive shall be sized 1.5 times the motor nameplate rating and also shall have ample strength to start the driven equipment by full voltage across-the-line motor starting.
- D. Where variable speed drive is specified, the drive sheave shall be of the variable pitch type which will provide a 5 percent speed variation of the driven equipment at the nominal rated speed. However, the higher speed side shall not cause the driven equipment to draw more than full nameplate rating horsepower from the driver.

2.5 CENTRIFUGAL UTILITY FANS

- A. Fans shall be centrifugal type. Unless spark resistant construction or other materials of construction are specified, fans shall be all welded steel construction with backward inclined airfoil blades continuously welded to the wheel flange and back plate. Fan housings are to be

constructed of heavy gauge steel with sides and scroll continuously welded. Bearings shall be pillow block type rigidly mounted on steel structural members. Shaft shall be solid, turned, ground and polished hot-rolled steel with keyways, keys and set-screws for attachment of both the fan wheel and drive sheave and countersunk at drive end for tachometer readings. Shaft shall be statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower. Shaft shall be designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

- B. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Twin City Fan Company.
 - 2. Loren Cook Company.
 - 3. Greenheck
 - 4. PennBarry
 - 5. Or prior approved equivalent

- C. Description: Factory-fabricated, assembled, tested, and finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.

- D. Housings: Formed panels to make curved-scroll housings with shaped cutoff, with doors or panels to allow access to internal parts and components.
 - 1. Panel Bracing: Steel angle or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 2. Horizontally split, bolted-flange housing.
 - 3. Spun inlet cone with flange.
 - 4. Outlet flange.

- E. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
 - 1. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 - 2. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 3. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
 - 4. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 - 5. Motor Mount: Adjustable for belt tensioning.

- F. Accessories:
 - 1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
 - 2. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
 - 3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 - 4. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
 - 5. OSHA Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.6 PROPELLER FANS

- A. Propeller fans shall be steel construction with cast aluminum, fabricated steel or aluminum propellers. Plastic fan propellers are not acceptable. Fans shall be provided with discharge safety screen if not directly connected to ductwork. Provide neoprene vibration isolation at metal contacts and permanently lubricated, sealed ball bearings. When spark resistant construction is specified in the schedule, all electrical components shall be explosion proof. Unless spark resistant construction or other materials of construction are specified on the schedules housing shall be steel or aluminum.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Aerovent; a Twin City Fan Company.
 - 2. Loren Cook Company.
 - 3. Greenheck
 - 4. PennBarry
 - 5. Or prior approved equivalent.

2.7 CENTRIFUGAL WALL AND ROOF EXHAUST FANS

- A. Centrifugal wall and roof exhaust fans shall be furnished with removable discharge safety/bird screen and inlet safety screen if not directly connected to duct work. Motor and drive shall be located out of the exhaust air stream. Curbs shall provide level fan mounting surfaces regardless of roof pitch. Provide neoprene vibration isolation at metal contacts and permanently lubricated, sealed ball bearings. Fan wheel shall be backward inclined. When spark resistant construction is specified in the schedule all electrical components shall be explosion proof. Fans shall be aluminum construction with spun aluminum drive housing and shroud unless other materials of construction are specified on the schedule.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Twin City Fan Company.
 - 2. Loren Cook Company.
 - 3. Greenheck
 - 4. PennBarry
 - 5. Or prior approved equivalent.

2.8 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with 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. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Support floor-mounting units using spring isolators having a static deflection of 1 inch. Vibration devices are specified in Section 23 05 48.
 - 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
- C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 - Cast-in-Place Concrete.
- D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- E. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 23 05 48 - Vibration Isolation.
- F. Install units with clearances for service and maintenance.
- G. Label fans according to requirements specified in Division 22 Section "Mechanical Identification."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 22 and 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 32 00 – Sheet Metal Accessories.
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.
- D. Ground equipment according to Section 26 05 26 - Grounding and Bonding.
- E. Connect wiring according to Section 26 05 19 - Low Voltage Electrical Power Conductors & Cables.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Refer to Section 23 05 93 – Testing, Adjusting & Balancing for testing adjusting, and balancing requirements.
10. Remove and replace malfunctioning units and retest as specified above.

- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 23-34-00

Diffusers, Registers and Grilles

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
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SECTION 23 37 13 – DIFFUSERS, REGISTERS AND GRILLES

PART 1 GENERAL

1.1 SCOPE

- A. Furnish and install the following:
 - 1. Grilles & registers.
 - 2. Ceiling diffusers.

1.2 QUALITY ASSURANCE

- A. Air distribution devices shall be as manufactured by Nailor Industries or prior approved equal.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Arrange product delivery to minimize storage time. Store air distribution devices in cartons in position indicated on box until installation. Handle air devices with care to prevent damage to finishes.

PART 2 PRODUCTS

2.1 See Drawing Schedule for Diffuser, Register and Grille requirements.

2.2 FINISHES

- A. Furnish all air distribution devices with prime coated and white baked enamel finish coat unless specified otherwise.

PART 3 EXECUTION

3.1 INSPECTION

- A. Inspect air devices for scratches and dents after installation. Repair dents and touch up scratches. If damage is still visible replace device.

3.2 INSTALLATION

- A. Suspend ceiling air devices from structure on wire hangers or from rigid ductwork. Ceiling must not be used to support air distribution devices.
- B. Verify compatibility of air devices with specific ceiling types.

END OF SECTION 23-37-13

Expansion Tanks

Reason for Issue: Construction Specification

Lead Engineer: Justin Thibodeaux

Submittal Date: 10/20/2023

| Revision | Date | Reviewed By | Checked By |
|----------|------------|-------------------|--------------|
| 0 | 10/20/2023 | Justin Thibodeaux | John T. Wade |
| | | | |
| | | | |

SECTION 23 77 13 – EXPANSION TANKS

PART 1 GENERAL

1.1 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings of the tank support frames for structural review, and tank Drawings, including details and catalogue cuts of any standard components being incorporated into the system.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Replaceable bladder type expansion tanks shall be pre-charged replaceable bladder type equal to Explanflex Type 'AL', ITT Series 'B', Armstrong Type 'L', or Amtrol Extrol Series 'L' stamped 800 kPa (125 psi) operating pressure.
 - 1. Tanks shall be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.
 - 2. Tanks shall be all steel construction and replaceable bladder shall be heavy duty butyl rubber compound.
 - 3. Tank shall include 38mm (1-1/2 in.) threaded bottom inlet, air pressure gauge, 19mm (3/4 in.) drain valve, and air inlet connection to facilitate adjusting of pre-charge pressure to meet actual system conditions.
 - 4. Tanks shall be complete with ring base, and lifting rings.
 - 5. Tanks shall have capacities as indicated in the Expansion Tank Schedule.
 - 6. Tanks on domestic water systems shall be listed for that application.
 - 7. Tanks shall have capacities as indicated on the Drawings.
- B. Diaphragm type expansion tanks shall be pre-charged diaphragm type equal to Explanflex Type 'OT', ITT Series 'D' or Armstrong Type 'AX' stamped 800 kPa (125 psi) operating pressure.
 - 1. Tanks shall be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.
 - 2. Tanks shall be all steel construction with integral heavy duty butyl rubber diaphragm.
 - 3. Tanks shall be complete with lifting rings, NPT system connection, and air inlet connection to facilitate adjusting pre-charge pressure to meet actual system conditions.
 - 4. Tanks shall be complete with saddles.
 - 5. Tanks shall have capacities as indicated in the Expansion Tank Schedule.
 - 6. Tanks shall have capacities as indicated on the Drawings.
- C. Water Pressure Reducing Valve: Watts, or Cash Acme, equal to Watts UB5, screwed with bronze body for operating pressures up to 2070 kPa (300 psi) at 71 deg. C. (160 deg. F.). Upstream from pressure reducing valve, provide a backflow preventer equal to Watts No. 9 or 909 acceptable under the requirements of the Ontario Water Resources Act. Downstream from pressure reducing valve, provide a pressure relief valve. All components of valves in contact with water shall be non-ferrous. Set pressure reducing valve at 140 kPa (20 psig) and pressure relief valve at 210 kPa (30 psig). Pipe pressure relief valve to nearest floor drain.

- D. Expansion tanks used for Glycol systems shall not have a cold water make-up connection

PART 3 EXECUTION

3.1 INSTALLATION

- A. Expansion tanks shall be self-supporting and shall be placed on 100mm housekeeping pads.
- B. Provide 19 mm (3/4 in.) drain line to nearest floor drain.
- C. Hang expansion tanks from roof structure on angle iron frame. Support tank below each saddle. Refer to Drawings for additional details.
- D. Support expansion tank on angle iron frame welded to base plate anchored to floor with self drilling anchor bolts cross brace with angle irons.

END OF SECTION 23-77-13

SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY:

- A. This section supplements all sections of this Division and shall apply to all phases of work specified herein, shown on the drawings, or required to provide a complete installation of electrical systems.

1.2 SUBMITTALS:

- A. GENERAL: Submit all necessary shop drawings and factory literature for Architect/Engineer approval.
 - 1. All shop drawings and submittals shall be approved prior to final fabrication and/or purchase.
 - 2. Shop drawings shall fully explain all procedures involved in executing a complete operational electrical work.
 - 3. Factory literature shall be specific for all factory assembled equipment, fixtures, devices, and items of equipment.
 - 4. All submittals shall properly indicate the pertinent equipment and their external connections for field installation and the necessary field installation instruction.
 - 5. All shop drawings and submittals shall be submitted in the required number of copies and on type of paper in conformance with the GENERAL CONDITIONS.
- B. SAMPLES: Submit samples upon request for approval. Each sample is to include proper tag indicating project and intended location and function.
- C. OPERATING INSTRUCTIONS: Include in the electrical work the issuance of operating instructions for all equipment requiring service and operator input.
 - 1. Provide qualified personnel for all electrical systems demonstration during training. The date(s) for training will be determined by the owner.
 - 2. At completion of work provide three (3) copies of all pertinent operating and maintenance instructions in 3-hole binder manual. Submit to Architect/Engineer. Divide with tabs by MCS specification division.
 - 3. Provide the name, address, and telephone number of the manufacturer's local service representative of each item of equipment included in the above requirements.

1.3 QUALITY ASSURANCE:

- A. It is the intention of these specifications to indicate a standard of quality for all materials incorporated in this work. Manufacturer's names and catalog numbers are used to designate the item of equipment or material as a means of establishing grade and quality. Where several

Manufacturers are named, only the named manufacturer's products will be considered unless explicitly stated otherwise by the Architect.

- B. Where the phrase "OR APPROVED EQUIVALENT" or "OR EQUIVALENT" or "EQUIVALENT TO" or "ACCEPTED SUBSTITUTE" is used in these specifications, the names or name mentioned are to be used as a basis of quality. Other manufacturers will be

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considered if the quality of the proposed material is equivalent to that of materials named in the opinion of the Architect. However, such unnamed manufacturers' products will be considered as substitutions and shall not be used as a basis for bidding.

C. Basis of quality shall include material, workmanship, weight, finishes and gauges of material, appearances, capacity and performance. Manufacturer's representation as to availability of equipment, replacement parts and service personnel in the area will be a factor in consideration of submittals.

D. Furnish standard products and manufacturers regularly engaged in production of such equipment.

E. Furnish manufacturer's latest standard design.

F. All materials shall be fully warranted.

G. All equipment shall conform to applicable IEEE, UL, ANSI and/or NEMA Standards.

H. Obtain manufacturer's recommendations and instructions for all installed equipment including installation instructions, preparation cleaning, tests and pre-service checks, and then ensure all have been performed prior to completion of work.

1.4 DESCRIPTION OF WORK:

A. SPECIFICATIONS AND DRAWINGS: Shall be complementary and be used for the complete interpretation of the electrical work.

1. Unless noted or modified by specific notation to the contrary, the indication and/or description of any electrical item in the documents carries with it the instruction to furnish, install and connect same. It shall be understood that the intent governs the work, regardless of whether or not this instruction is explicitly stated. The use of the words "furnish" or "provide" with the absence of the word "install" shall be defined to include the installation and connection of the equipment and/or materials unless specific instructions are included for others to install and/or connect.

2. No exclusion from or limitation in drawings or specifications for the electrical work shall be reason for omitting the appurtenances, accessories, or devices necessary to complete any required system or item of equipment or compliance with codes.

3. The drawings are shown in part diagrammatic, intended to convey the scope of work, indicating the general arrangement of equipment, conduit and outlets. Follow the drawings in laying out the work and verify places for the installation of the materials and equipment. Wherever a question exists as to the exact intended location of outlets or equipment, obtain instructions from the Architect before proceeding with the work.

B. WORK INCLUDED: Furnish all labor, material, services and skilled supervision necessary for the construction, erection installation, connections, testing and adjustment of all circuits and electrical equipment specified herein, or shown or noted on the drawings, and its delivery to the owner complete in all respects ready for use.

D. The dimensions of the Distribution Equipment shown on the drawings are based on products as manufactured by Square D Company. The equipment has been arranged in the space to comply with NEC required clearances. It is the Contractor's responsibility to ensure NEC required clearances are maintained if equipment from manufacturers other than Square D are used and shall make any adjustment necessary with the Architect's approval at no cost to the Owner.

1.5 SYSTEM DESCRIPTION:

A. Electric Service System: 480Y/277 volts, three phase, four wire, 60 Hz.

1.6 PROJECT CONDITIONS:

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A. Verify field measurements for the equipment to ensure proper fit within the space proposed.

1.7 UTILITY REQUIREMENTS:

A. Metering shall be provided by the utility company.

1. Coordinate with the utility for exact metering requirements.
2. Install metering devices provided by the utility company.

B. Pay for all assessments, charges, etc. required by the utility for service requirements. Provide concrete pad for utility padmount transformer per utility requirements.

C. COORDINATION OF WORK:

1. Plan all work so that it proceeds with a minimum of interference with other trades. Inform all parties of openings required for equipment or conduit in the building construction for electrical work and provide all special frames, sleeves and anchor bolts as required. Coordinate the electrical work with the mechanical installation.
2. Work lines and established heights shall be in strict accordance with architectural drawings and specifications insofar as these drawings and specifications extend. Verify all dimensions shown and establish all elevations and detailed dimensions not shown.
3. Lay out and coordinate all work well enough in advance to avoid conflicts or interferences with other work in progress so that in case of interference the electrical layout may be altered to suit the conditions, prior to the installation of any work and without additional cost to the owner. Conflicts arising from lack of coordination shall be this Contractor's responsibility.

D. COOPERATION WITH OTHER TRADES:

1. Perform this work in conformity with the construction called for by other trades and afford reasonable opportunity for the execution of their work. Properly connect and coordinate this work in such a manner as not to delay or interfere with the work of other trades.
2. Examine the drawings and specifications for the general and mechanical work and the work of other similar trades. Coordinate this work accordingly.
3. Promptly report to the Architect any delay or difficulties encountered in the installation of this work which might prevent prompt and proper installation, make it unsuitable to connect with or receive the work of others. Failure to so report shall constitute an acceptance of the work of other trades as being fit and proper for the execution of this work.

1.8 AS-BUILT RECORD DRAWINGS/OPERATION AND MAINTENANCE MANUALS:

A. At completion of job, provide the Architect with electrical drawings reflecting all as built conditions. Provide number of copies as required by the General Conditions.

B. At the completion of the job provide the Architect with operation and maintenance information on all electrical materials and equipment requiring periodic maintenance and/or user interface. Each set have its own CD with case. Label CD with typewritten label (12pt font minimum) that is made for this application. Label should indicate the Project Name followed by "Electrical Operating And Maintenance Instructions/As Built Drawings," and at the bottom of the CD, label shall read, "Warning: Data

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stored on CD's have a life of 2 to 5 years. Migrate data to other storage medium(s) periodically to avoid loss of data." Provide number of copies as required by the General Conditions.

1.9 CODES, PERMITS AND FEES:

A. CODES: All work shall meet or exceed all legal requirements and the latest requirements of the National Electric Code, and all State, County, Municipal and other authorities having jurisdiction over electrical construction work at the project. Comply with all applicable building ordinances and codes. Where the contract documents exceed minimum requirements, the contract documents take precedence.

B. PERMITS AND FEES: Comply with all requirements for permits, licenses, and fees. Permits, licenses, fees and any other documentation required and arrangements required for the work under this contract shall be obtained by the Contractor at his expense, and made available at the completion of the work, unless otherwise specified. Comply with the requirements of the applicable utility companies serving this project. Make all arrangements with the utility companies for proper coordination of the work.

1.10 MATERIALS AND EQUIPMENT FURNISHED BY THE OWNER:

A. The electrical work (if noted on the Drawings or within the specifications includes) the installation and/or connection of certain materials and equipment furnished by the owner. For material or equipment provided by the owner, the Contractor shall do the following:

1. Coordinate all deliveries.
2. Unload from arriving delivery vehicles at any designated area on the job site.
3. Examine all items for all damages incurred during delivery for claims to repair and/or replace the same.
4. Handle and store on field storage area and coordinate security until the time of permanent placement.
5. Provide foundations and housekeeping pads for apparatus and equipment as required by other sections of the specification and /or drawings.
6. Mount in place and provide supporting members and fastening necessary to accommodate specific loading requirements.

1.11 OBSERVATION, TESTING AND BALANCING

A. Observation: The complete job will be, during and/or after construction, subject to the administration of the Architect. Site visits shall be conducted by the Architect or his designated representative as necessary to maintain compliance with the Contract requirements.

B. Testing: Prior to acceptance by the Owner/Architect, the Contractor shall conduct and record insulation tests of all feeder and motor branch circuits. The insulation testing shall be accomplished utilizing an meg-ohm meter. Verification of test results shall be witnessed by the Architect or his designated representative. The Contractor shall submit a written report of all readings of each feeder and circuit.

C. Balancing: All branch circuits and feeders shall be tested under maximum and typical load conditions, and loads shall be balanced on the phases of the electrical system. The Contractor shall submit written report of final load readings of all loads on each feeder.

1.12 WORKMANSHIP

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- A. All work shall be executed in a neat and substantial manner by skilled workman, well qualified, and regularly engaged in the type of work required. Substandard work shall be removed and replaced by the Contractor at no cost to the Owner.

1.13 COMPLIANCE

- A. In the event of a conflict between Specifications, Drawings, Codes, Requirements, etc., the most stringent requirements shall govern.
- B. The interpretation of conflicts and resolution thereof shall remain the right of the Architect/Engineer or his designated representative.

1.14 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work as required.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS:

A. GENERAL:

1. Equipment and fixtures shall be connected providing circuit continuity in accordance with applicable codes whether or not each conductor, conduit, or protective device is shown between such items of equipment or fixtures and the point of circuit origin.
2. Unless otherwise specified, equipment and materials of the same type or classification, and used for the same purpose, shall be products of approved manufacturers.
3. Use only new, unweathered, and unused material, except as specifically noted.

B. APPLICABLE DOCUMENTS: Design, manufacture, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications of standard rules of the following:

| | | | |
|--|----------|--------------------------------------|------|
| American Institute of Steel Construction | AISC | National Electrical Safety Code | NESC |
| American Society for Testing & Materials | ASTM | National Fire Protection Assoc | NFPA |
| Federal Specifications | FED SPEC | Occupational Safety & Health Act | OSHA |
| Institute of Electrical & Electronic Engineers | IEEE | Underwriters' Laboratories, Inc | UL |
| Insulated Power Cable Engineers Assoc | IPCEA | American National Standard Institute | ANSI |
| National Electrical Code | NEC | International Electrical Counsel | IEC |
| National Electrical Manufacturer's Assoc | NEMA | Americans with Disabilities Act | ADA |
| International Energy Conservation Code | IECC | Applicable Utility Companies | |
| Applicable Building Code | | | |

C. IDENTIFICATION OF EQUIPMENT: Identify, individually, each piece of equipment with a laminated micarta nameplate black/white core and 1/4" high engraved letters. Temporary identification is required upon installation.

1. Equipment to be labeled.
 - a. Distribution and Lighting and Appliance Panelboards, Dry-Type Transformers

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- b. Disconnect Switches (with name of equipment served)
 - c. Motor Starters and VFD's
 - c. Telephone Cabinets and Backboards
 - d. Lighting Control Panels, Contactors
2. Do not use abbreviated terms for identification. Spell out in full the proper name and number of each identified equipment, i.e., PANEL-LPA-1 or AIR HANDLING UNIT - AH 5

PART 3 - EXECUTION

3.1 GENERAL:

A. **EQUIPMENT AND MATERIAL:** Install in a neat and workmanlike manner and align level and adjust for satisfactory operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance and repair. Where marring or disfigurement has occurred, replace or refinish the damaged surfaces as directed and to the satisfaction of the Architect and the owner.

B. **SUPPORTS:** Provide the design, fabrication and erection of supplementary structural framing required for attachment of hangers or other devices supporting electrical equipment.

- 1. Provide framing members of standard rolled steel shapes, A-36 steel. Provide members welded to structural members equal to the specification for the main structural member. Provide "simple beam" type framing with end connections welded or bolted for shear loads. Use cantilevers only when detailed or specifically approved by the Architect. The Architect's and approval are required for location of supplementary framing. Use only certified welders.
- 2. The use of roof deck or ceiling system for support of lighting fixtures, conduit, raceways, and other electrical equipment is not permitted. Provide beam clamps, hanger rods, conduit and pipe hangers/ supports and straps.

C. OUTLET LOCATION:

- 1. Center all outlet boxes with regard to paneling, furring and trim. Repair or replace damaged finishes. Set outlet boxes plumb and flush with the finished surface of the wall, ceiling or floor without projecting beyond same.
- 2. Install symmetrically all receptacles, switches, and devices shown and where necessary set the long dimension of the plate horizontal or ganged in tandem.
- 3. Group under common (multi-toggle) plate more than one device in the same location.
- 4. Coordinate with Architectural, Mechanical and Structural Drawings to determine location of any element or feature that may affect the location of device boxes. The intent is to provide symmetry and balance on walls and ceilings as well and maintaining NEC requirements.

D. CUTTING, PATCHING AND PIERCING:

- 1. Obtain Architects written permission before cutting or piercing structural members.
- 2. Use craftsmen skilled in their respective trades for cutting, fitting, repairing, patching of plaster and finishing of materials including carpentry work, metal work or concrete work required for this work. Do not weaken walls, partitions or floors with cutting. Holes required to be cut in floors must be drilled without excessive breaking out around the holes. Patching and/or refinishing will be determined by the Architect.

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3. Sleeves shall be installed flush with finished walls, finished ceilings or finished floors and
4. Roof penetrations and repairs shall be performed by others under the direction of the General Contractor and Architect.
5. Provide watertight conduit openings through floor slabs, masonry walls and continuous partitions. Tightly caulk space between conduit and building materials with a non-flammable sealant.
6. Seal equipment or components exposed to the weather and make watertight and insect proof. Protect equipment outlets and conduit openings with temporary plugs or caps at all times that work is not in progress.
7. This Contractor shall provide all cutting, digging, etc., incident to his work and shall make all required repairs thereafter to the satisfaction to the Engineer, but in no case shall the Contractor cut into any major structural element, beam, or column without written approval of the Engineer.
8. Pavements, sidewalks, roads, curbs, walls, ceilings, floors, and roofs shall be cut, patched, repaired and/or replaced as required to permit the installation of the electrical work.
9. The Contractor shall bear the expense of all cutting, patching, painting, repairing, or replacing of the work of other trades required because of his fault, error, or tardiness or because of any damage done by him.

E. SPECIAL CONSIDERATIONS:

1. Locate pull boxes to provide easy access for operation, repair and maintenance, and, if concealed, provide access doors. Locate switches and receptacles as shown on the drawings. Where several are grouped at a location do not spread them along the wall.
2. Take such precautions as necessary to properly protect all apparatus, fixtures, appliances, material, equipment and installations from damage of any kind. The Architect may reject any particular piece or pieces of material, apparatus or equipment scratched, dented or otherwise damaged.
3. Prepare all exposed fittings, boxes, supports and panel boards for painting by removing all oil, grease and dirt. Employ the necessary precautionary methods to prevent scratching or defacing of all electrical apparatus and devices.
4. Exposed conduit installed after room has been painted shall be painted to match room finish by this Contractor.
5. Provide hot dip galvanized components for ferrous materials exposed to the weather.
6. Cables installed under these specifications for termination by others shall be labeled at the terminating end(s) with identification as to type of system and the area(s) served by the devices on the contractor connected end.
7. All spares delivered to the owner under the requirements of these specifications shall be accompanied by an inventory listing. The listing will be verified by the owner and signed for verification of delivered quantities. The contractor shall send the signed listing to the Architect.

F. NOISE LIMITATION:

1. Perform all work to assure minimal noise produced by the electrical equipment and installation.
2. Check and tighten all plates, covers, doors and trims used in conjunction with electrical equipment.

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3. Remove and replace any device or equipment which is found to emit noise level higher than industry standards. Perform all work in accordance with the field instructions issued by the Architect to alleviate such conditions.
4. All equipment requiring tightening and all device, lug and connector terminals shall be tightened to the manufacturer's prescribed torque value.

3.2 TESTS:

- A. Perform all tests deemed necessary to establish full conformance with the specifications, their intent, drawings and suitable operation of each system.
- B. Tests shall be conducted under the supervision of the Architect or the owner and the equipment vendor. Testing and commissioning shall be scheduled to accommodate the Owner's schedule.
- C. Correct promptly all defects and deficiencies discovered in any of the electrical work during testing and demonstrate compliance to this effect.

3.3 WARRANTY AND CERTIFICATIONS:

- A. WARRANTY: Workmanship, labor, equipment, materials, related components and accessories shall be free from defects, and shall remain so for a period of one year from the date of project acceptance.
- B. CERTIFICATIONS: All certificates required by governing authorities shall be submitted with no reservations attached.

3.4 FINAL INSPECTION AND CORRECTION: THIRTY (30) DAYS AFTER THE
CERTIFICATE OF OCCUPANCY HAS BEEN ISSUED: Arrange with the Owner for final
inspection and correction. The following shall be performed.

- A. All distribution system electrical joints (field or factory) shall be checked for tension and re tightened.
- B. All excessive noise producing equipment shall be checked for cause and corrected if it is electrically produced.
- C. Check the electrical installation visually for any missing or broken component and replace same.

END OF SECTION

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Heat shrink tubing.
- E. Oxide inhibiting compound.
- F. Wire pulling lubricant.
- G. Cable ties.

1.2 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- C. Section 26 2100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.
- D. Section 28 3100 - Fire Detection and Alarm: Fire alarm system conductors and cables.
- E. Section 31 2316 - Excavation.
- F. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- G. Section 31 2323 - Fill: Bedding and backfilling.

1.3 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- G. NEMA WC 70 - Nonshielded Power Cable 2000 V or Less for the Distribution of Electrical Energy; 2009.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- K. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- M. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

- N. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- O. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 26 0526.
- H. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
- I. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.

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- 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
- 3. Tinned Copper Conductors: Comply with ASTM B33.
- J. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 2. Control Circuits: 14 AWG.
- K. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- L. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 - 3. Color Code:
 - a.

| 120/208 Volt System | 277/480 Volt System |
|---------------------|------------------------|
| Phase A - Black | Phase A - Brown |
| Phase B - Red | Phase B - Orange |
| Phase C - Blue | Phase C - Yellow |
| Neutral - White | Neutral Natural - Grey |
 - b. Equipment Ground, All Systems: Green.
 - c. Isolated Ground, All Systems: Green with yellow stripe.
 - d. Travelers for 3-Way and 4-Way Switching: Pink.
 - e. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 - 1. Copper Building Wire:
 - a. Cerro Wire LLC
 - b. Encore Wire Corporation
 - c. Southwire Company
 - d. General Cable
 - e. Substitutions: See Section 01 6000 – Product Requirements.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
 - 2. Control Circuits: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.
 - a. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

2.4 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 0526.
- C. Wiring Connectors for Splices and Taps, In Indoor Locations:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Splices and Taps, In Below Grade or Pull-box Locations:
 - 1. Copper Conductors, All Sizes: Use pre-insulated mechanical splices pre-filled with oxide inhibiting compound. UL listed.
 - 2. Suitable for 90 degree C connections at 600 volts. Insulation shall be rubber/vinyl coating, high dielectric.
 - 3. Acceptable Manufacturers: Greaves-USA or approved equal.
- E. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 - 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 - 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 - 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
- F. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- G. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- H. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
 - 1. Manufacturers:
 - a. 3M
 - b. Ideal Industries, Inc
 - c. NSI Industries LLC
- I. Mechanical Connectors: Provide bolted type or set-screw type.
 - 1. Manufacturers:
 - a. Burndy
 - b. IlSCO
 - c. Thomas & Betts Corporation
- J. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 - 1. Manufacturers:
 - a. Burndy
 - b. IlSCO
 - c. Thomas & Betts Corporation
- K. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
 - 1. Manufacturers:
 - a. Burndy
 - b. IlSCO
 - c. Thomas & Betts Corporation

2.5 WIRING ACCESSORIES

- A. Electrical Tape:
 - 1. Manufacturers:
 - a. 3M
 - b. Plymouth Rubber Europa
 - 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 - 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
 - 4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 - 5. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
 - 6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
- B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
 - 1. Manufacturers:
 - a. Burndy
 - b. Ideal Industries, Inc
 - c. IlSCO
- C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
 - 1. Manufacturers:
 - a. 3M
 - b. American Polywater Corporation
 - c. Ideal Industries, Inc
- D. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as shown on the drawings.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

- A. Circuiting Requirements:
 - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 - 2. When circuit destination is indicated and routing is not shown, determine exact routing required.
 - 3. Arrange circuiting to minimize splices.
 - 4. Include circuit lengths required to install connected devices within 10 ft. of location shown.
 - 5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.

6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is not permitted.
 8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.
- D. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 2. Pull all conductors and cables together into raceway at same time.
 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
- G. Install conductors with a minimum of 12 inches of slack at each outlet.
- H. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- K. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 3. Do not remove conductor strands to facilitate insertion into connector.
 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.
 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors. Apply oxide inhibiting compound on all splices and terminations in damp or wet locations, including hand-holes of lighting standards.
1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 - b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.

- b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 - 3. Wet Locations: Use pre-insulated mechanical connectors in wet locations including splices or taps in flush grade pull-boxes.
 - M. Insulate ends of spare conductors using vinyl insulating electrical tape.
 - N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
 - O. Identify conductors and cables in accordance with Section 26 0553.
 - P. Install fire-stopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
 - Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.
- 3.4 FIELD QUALITY CONTROL
- A. See Section 01 4000 - Quality Requirements, for additional requirements.
 - B. Inspect and test in accordance with NETA ATS, except Section 4.
 - C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
 - 1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
 - D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
 - 1. Includes oxide inhibiting compound.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 5600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.3 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2007.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. For signal reference grids, coordinate the work with access flooring furnished in accordance with Section 09 6900.
 - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- B. Field quality control test reports.
- C. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
 - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- E. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
 - 3. Metal Building or Structure Frame:
 - a. Provide connection to metal building or structure frame effectively grounded in accordance with NFPA 70 at nearest accessible location.
 - 4. Ground Rod Electrode(s):
 - a. Provide single electrode unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - 5. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
 - 6. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
 - a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
 - c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
- F. Bonding and Equipment Grounding:
 - 1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 - 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.

3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
- G. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
 2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
- H. Pole-Mounted Luminaires: Also comply with Section 26 56 00.

2.2 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
1. Use insulated copper conductors unless otherwise indicated.
- C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
 - a. Exceptions:
 - 1) Use exothermic welded connections for connections to metal building frame.
- D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
 2. Size: As indicated.
 3. Holes for Connections: As indicated or as required for connections to be made.
- E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
 2. Material: Copper-bonded (copper-clad) steel.
 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.

- B. Verify that field measurements are as shown on the drawings.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
 - 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
 - 2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
- D. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Install ground bars located outdoors in a NEMA 3R PVC enclosure with clear polycarbonate cover and stainless steel screws.
- F. Identify grounding and bonding system components in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 26 0534 - Conduit: Additional support and attachment requirements for conduits.
- D. Section 26 0537 - Boxes: Additional support and attachment requirements for boxes.
- E. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- F. Section 26 5600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2013.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 5. Do not use chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use NEMA 412 stainless steel unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
- D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
 2. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use hot dipped galvanized steel.
 3. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
 4. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
- E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Single Conduit up to 1 inch (27mm) trade size: 1/4 inch diameter.
 - c. Single Conduit larger than 1 inch (27mm) trade size: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
 - e. Outlet Boxes: 1/4 inch diameter.
- F. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 4. Hollow Masonry: Use toggle bolts.
 5. Hollow Stud Walls: Use toggle bolts.
 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 7. Sheet Metal: Use sheet metal screws.
 8. Plastic and lead anchors are not permitted.
 9. Powder-actuated fasteners are not permitted.
 10. Hammer-driven anchors and fasteners are not permitted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Conduit Support and Attachment: Also comply with Section 26 0534.
- I. Box Support and Attachment: Also comply with Section 26 0537.
- J. Interior Luminaire Support and Attachment: Also comply with Section 26 5100.
- K. Exterior Luminaire Support and Attachment: Also comply with Section 26 5600.
- L. Secure fasteners according to manufacturer's recommended torque settings.
- M. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 05 29

SECTION 26 05 34 – CONDUIT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Intermediate metal conduit (IMC).
- C. Flexible metal conduit (FMC).
- D. Liquidtight flexible metal conduit (LFMC).
- E. Electrical metallic tubing (EMT).
- F. Rigid polyvinyl chloride (PVC) conduit.
- G. Liquidtight flexible nonmetallic conduit (LFNC).
- H. Conduit fittings.
- I. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0537 - Boxes.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 2100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
- G. Section 27 1005 - Structured Cabling for Voice and Data - Inside-Plant: Additional requirements for communications systems conduits.

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
- E. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.
- F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- G. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2005.
- H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.
- I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- L. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- M. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- N. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

- O. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- P. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- Q. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.
- R. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
 - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Under Slab on Grade: Use rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 - 3. Exterior, Embedded within Concrete: Use rigid PVC conduit.
 - 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
 - 5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
- D. Embedded Within Concrete:
 - 1. Within Slab on Grade: Not permitted except where cutting and patching for floor receptacles is shown or required. Use rigid PVC conduit in these instances.
 - 2. Within Concrete Walls Above Ground: Use rigid PVC conduit.
 - 3. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.
- E. Concealed within Masonry Walls: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).

- F. Concealed within Hollow Stud Walls: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit.
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
 - 1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
- K. Exposed, Exterior: Use galvanized steel rigid metal conduit. Use intermediate metal conduit (IMC) only where specifically indicated on the Drawings.
- M. Feeders: Use galvanized steel rigid metal conduit for exposed and above ceiling applications between panelboards.
- N. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
 - 1. Maximum Length: 6 feet.
- O. Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit.
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
 - 3. Maximum Length: 6 feet unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.

2.2 CONDUIT REQUIREMENTS

- A. Electrical Service Conduits: Also comply with Section 26 2100.
- B. Communications Systems Conduits: Also comply with Section 27 1005.
- C. Fittings for Grounding and Bonding: Also comply with Section 26 0526.
- D. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- E. Provide products listed, classified, and labeled as suitable for the purpose intended.
- F. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 1/2 inch (16 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
 - 3. Control Circuits: 1/2 inch (16 mm) trade size.
 - 4. Flexible Connections to Luminaires: 3/8 inch (12 mm) trade size.
 - 5. Underground, Interior: 3/4 inch (21 mm) trade size.
 - 6. Underground, Exterior: 1 inch (27 mm) trade size.
- G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit
 - 2. Republic Conduit
 - 3. Wheatland Tube Company
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc.
 - b. O-Z/Gedney
 - c. Thomas & Betts Corporation: www.tnb.com.
 - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

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3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.4 INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufacturers:
 1. Allied Tube & Conduit: www.alliedeg.com.
 2. Republic Conduit: www.republic-conduit.com.
 3. Wheatland Tube Company: www.wheatland.com.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
 1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 4. Connectors and Couplings: Use threaded type fittings only. Thread-less set screw and compression (gland) type fittings are not permitted.

2.5 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
 1. AFC Cable Systems, Inc.
 2. Electri-Flex Company
 3. International Metal Hose
- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- C. Fittings:
 1. Manufacturers:
 - a. Bridgeport Fittings Inc.
 - b. O-Z/Gedney, a brand of Emerson Industrial Automation
 - c. Thomas & Betts Corporation
 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
 1. AFC Cable Systems, Inc
 2. Electri-Flex Company
 3. International Metal Hose
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
 1. Manufacturers:
 - a. Bridgeport Fittings Inc.

- b. O-Z/Gedney
- c. Thomas & Betts Corporation
- 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
- 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.

2.7 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Allied Tube & Conduit
 - 2. Republic Conduit
 - 3. Wheatland Tube Company
- B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc.
 - b. O-Z/Gedney
 - c. Thomas & Betts Corporation
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 - 4. Connectors and Couplings: Use compression (gland) or set-screw type.
 - a. Do not use indenter type connectors and couplings.

2.8 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 - 1. Cantex Inc.
 - 2. Carlon
 - 3. JM Eagle
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651 ; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.9 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

- A. Description: NFPA 70, Type LFNC liquid-tight flexible nonmetallic conduit listed and labeled as complying with UL 1660 .
- B. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

2.10 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.
- D. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- E. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.
- F. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic. The Contractor shall arrange and perform a pre-installation planning meeting with the Architect and Engineer to specifically locate raceway (and cables) on exposed beams and columns.
 - 2. When conduit destination is indicated and routing is not shown, determine exact routing required.
 - 3. Conceal all conduits unless specifically indicated to be exposed.
 - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
 - 5. Unless otherwise approved, do not route conduits exposed:
 - a. Across floors.
 - b. Across roofs.
 - c. Across building exterior surfaces.
 - 6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 7. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
 - 9. Arrange conduit to provide no more than 150 feet between pull points.
 - 10. Route conduits above water and drain piping where possible.
 - 11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 - 12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 - 13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
 - 14. Group parallel conduits in the same area together on a common rack.
- G. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 - 4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 - 5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 - 6. Use conduit clamp to support single conduit from beam clamp or threaded rod.

7. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
 8. Use of spring steel conduit clips for support of conduits is permitted in above accessible ceiling installations for single raceway supports only.
 - a. Support of electrical metallic tubing (EMT) up to 1 inch (27 mm) trade size.
 9. Use of wire for support of conduits is permitted only as follows:
 - a. For suspending conduits supported by spring steel conduit clips (only where specifically indicated or permitted).
 10. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.
- H. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
 7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
 8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- I. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Conceal bends for conduit risers emerging above ground.
 5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
 6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
 7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
 9. Provide metal escutcheon plates for conduit penetrations exposed to public view.
 10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- J. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 31 2316.13.
 2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Under Slab on Grade: 12 inches to bottom of slab.
 3. Provide underground warning tape in accordance with Section 26 0553 along entire conduit length for service entrance where not concrete-encased.
- K. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.

- L. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
 - 1. Where conduits pass from outdoors into conditioned interior spaces.
 - 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
 - 3. Where conduits penetrate coolers or freezers.
 - M. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
 - N. Provide grounding and bonding in accordance with Section 26 0526.
 - O. Identify conduits in accordance with Section 26 0553.
- 3.3 FIELD QUALITY CONTROL
- A. See Section 01 4000 - Quality Requirements, for additional requirements.
 - B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
 - C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
 - D. Correct deficiencies and replace damaged or defective conduits.
- 3.4 CLEANING
- A. Clean interior of conduits to remove moisture and foreign matter.
- 3.5 PROTECTION
- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 05 34

SECTION 26 05 37 - BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Floor boxes.
- D. Underground boxes/enclosures.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 07 84 00 - Firestopping.
- C. Section 08 31 00 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- E. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- F. Section 26 05 34 - Conduit:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- G. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 26 27 26 - Wiring Devices:
 - 1. Wall plates.
 - 2. Floor box service fittings.
 - 3. Additional requirements for locating boxes for wiring devices.
- I. Section 27 10 05 - Structured Cabling for Voice and Data - Inside-Plant: Additional requirements for communications systems outlet boxes.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. SCTE 77 - Specification for Underground Enclosure Integrity; 2013.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

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1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures and floor boxes.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 BOXES

- A. General Requirements:
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes, PVC coated, for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use cast iron boxes or cast aluminum boxes when exposed galvanized steel rigid metal conduit is used.
 4. Use suitable concrete type boxes where flush-mounted in concrete.
 5. Use suitable masonry type boxes where flush-mounted in masonry walls.
 6. Use raised covers suitable for the type of wall construction and device configuration where required.
 7. Use shallow boxes where required by the type of wall construction.
 8. Do not use "through-wall" boxes designed for access from both sides of wall.
 9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A ; furnish with threaded hubs.

11. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 12. Boxes for Ganged Devices: Use multi-gang boxes of single-piece construction. Do not use field-connected gangable boxes.
 13. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: Comply with Section 27 10 05.
 - c. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
 - d. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
 14. Wall Plates: Comply with Section 26 27 26.
 15. Manufacturers:
 - a. Cooper Crouse-Hinds
 - b. Hubbell Incorporated; Bell Products
 - c. Hubbell Incorporated; RACO Products
 - d. O-Z/Gedney
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 4. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
- D. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 27 26; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
 2. Use cast iron floor boxes within slab on grade.
 3. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
 4. Manufacturer: Same as manufacturer of floor box service fittings.
- E. Underground Boxes/Enclosures:
1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
 2. Size: As indicated on drawings.
 3. Provide logo on cover to indicate type of service.
 4. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
 - a. Manufacturers:
 - b. Combination fiberglass/polymer concrete boxes/enclosures are not acceptable. Use all-polymer concrete boxes/enclosures.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

- B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130 , including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- F. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
 - 2. Unless dimensioned, box locations indicated are approximate.
 - 3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
 - b. Communications Systems Outlets: Comply with Section 27 10 05.
 - 4. Locate boxes so that wall plates do not span different building finishes.
 - 5. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 6. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
 - 7. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
 - 8. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - 9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 34.
- G. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
 - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
 - 4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
- H. Install boxes plumb and level.
- I. Flush-Mounted Boxes:
 - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 - 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- J. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- K. Underground Boxes/Enclosures:
 - 1. Install enclosure on gravel base, minimum 6 inches deep.
 - 2. Provide cast-in-place concrete collar constructed in accordance with Section 03 30 00, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
- L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- M. Install fire-stopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- N. Close unused box openings.

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- O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- P. Provide grounding and bonding in accordance with Section 26 05 26.
- Q. Identify boxes in accordance with Section 26 05 53.

3.3 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 26 05 37

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.3 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Panelboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location.
 - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
 - 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - c. Time Switches/Contactors:
 - 1) Identify load(s) served and associated circuits controlled. Include location.
 - 2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
- B. Identification for Conductors and Cables:
 - 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
 - 2. Identification for Communications Conductors and Cables: Comply with Section 27 1005.
 - 3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
 - 4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:

- a. At each source and load connection.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
- C. Identification for Devices:
- 1. Identification for Communications Devices: Comply with Section 27 1005.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
- 1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
 - 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 - 3. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
- 1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.
 - 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
- 1. Minimum Size: 1 inch by 2.5 inches.
 - 2. Legend:
 - a. Equipment designation or other approved description.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height:
 - a. System Designation: 1 inch.
 - b. Equipment Designation: 1/2 inch.
 - 5. Color:
 - a. Normal Power System:
 - 1) 208Y/120 V, 3 Phase Equipment: White text on black background.
- D. Format for General Information and Operating Instructions:
- 1. Minimum Size: 1 inch by 2.5 inches.
 - 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 1/4 inch.
 - 5. Color: Black text on white background unless otherwise indicated.
- E. Format for Caution and Warning Messages:
- 1. Minimum Size: 2 inches by 4 inches.
 - 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 1/2 inch.
 - 5. Color: Black text on yellow background unless otherwise indicated.
- F. Format for Control Device Identification:
- 1. Minimum Size: 3/8 inch by 1.5 inches.
 - 2. Legend: Load controlled or other designation indicated.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 3/16 inch.
 - 5. Color: Black text on clear background.

2.3 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
 - 1. Do not use handwritten text.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.

2.4 VOLTAGE MARKERS

- A. Minimum Size:
- B. Legend:
- C. Color: Black text on orange background unless otherwise indicated.

2.5 UNDERGROUND WARNING TAPE

- A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:
 - 1. Tape for Buried Power Lines: Black text on red background.
 - 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Conductors and Cables: Legible from the point of access.
 - 8. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
 - 1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION 26 05 33

SECTION 260913 - ELECTRICITY METERING AND POWER MONITORING

PART 1 - GENERAL

1.1 DOCUMENTS

1. Please note: that this section of the Specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts listed by the appropriate parties below.

1.2 SYSTEM DESCRIPTION

1. The products specified herein are intended to provide a complete sub-metering solution. This solution shall be utilized to measure and monitor owner provided utilities including, but not limited to, electricity, gas, water. System will also allow for compliance with national and local energy codes and provide equipment needed to meet specific LEED M&V credits.

1.3 SECTION INCLUDES

1. Electrical sub-metering equipment, data collection systems, and data management software systems including:
 - a. Standard single point kWh electrical sub-meters
 - b. Advanced single point kWh electrical sub-meters
 - c. Multi-point electrical sub-meters
 - d. Data collection hubs
 - e. High density pulse modules
 - f. Open protocol data communication network
 - g. Wireless communication devices
 - h. Energy monitoring

1.4 STANDARDS

1. Provide equipment of this Section in full compliance with the following applicable portions of the latest revisions of the following standards:
 - a. ANSI C12.1 & C12.20 at 0.5 Accuracy Class
 - b. UL Certified to IEC/EN/UL/CSA 61010-1 2nd Edition.
 - c. UL916:
 - i. These requirements cover energy management equipment and associated sensing devices rated 600 volts or less and intended for installation in accordance with the National Electrical Code, NFPA 70.
 - d. NEMA -ESM-1

1.5 SHOP DRAWINGS

1. Installation and Shop Drawings to include the following:
 - a. Manufacturer's literature and specification
 - b. Component connection wiring diagrams
 - c. Communications system specification

1.6 INSTALLATION, OPERATION, AND MAINTENANCE MANUALS

1. Submit installation, operation, and maintenance manuals for the electrical sub-metering system data collection system, and data management software.

1.7 TECHNICAL PERFORMANCE

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1. Minimum measured technical performance of each piece of installed equipment shall meet the specifications published by the manufacturer.
2. Optimize technical performance of all systems to produce the highest achievable technical performance to the satisfaction of consultant and/or client.
3. Any deficiencies in the system, particularly information communication errors or operational deficiencies, shall be cause for rejection. Rectify any such deficiencies prior to calling for substantial completion review.

1.8 WARRANTY

1. Manufacturer shall provide a comprehensive warranty for all products.
2. All electrical sub-meters included in this specification to be free from defects in materials and workmanship from the date of substantial completion for a period of 5 Years.
3. All data collection system components included in this specification to be free from defects in materials and workmanship from the date of substantial completion for a period of 5 Years.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

1. Acceptable Manufacturer: Leviton Manufacturing Co. Inc.
2. Basis of Design: Leviton VerifEye Metering System.
3. Substitutions [Permitted] [Not Permitted]:
 - a. Show all substitutions as an add or deduct from base bid pricing. b. Provide
Manufacturer's reference list.
 - c. Clearly delineate all propose substitutions as such and submit in writing for approval by the engineer a minimum of 10 working days prior to the bid date
 - d. Prior to rough-in, provide complete engineered shop drawings, including power wiring, with deviations for the original design highlighted in an alternate color, to the engineer for review and approval.
 - e. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.

2.2 METERS AND CURRENT TRANSFORMERS

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1. Standard single point metering devices: Leviton Mini-Meters, Series 1000, and Series 2000
2. Advanced single point metering devices: Leviton Series 3500, Series 4000 & Series 4100
3. Multipoint metering devices: Leviton Series 7000, 7100 or 8000
4. Leviton solid or split core current transformers with full scale output of 0.1A or 0.333v
5. Leviton Rogowski coil current transformers.
6. Solid Core current transformers available for 100-400A and split core current transformers available from 50A - 5,000A.
7. Current transformer secondary conductor wires can be extended:
 - a. 500' for 0.1A CT's
 - b. 300' for 0.333V CT's
 - c. 20' for Rogowski Coil CT's

2.3 SYSTEM DESCRIPTION – SINGLE POINT METERING DEVICES

1. Provide single point metering devices capable of metering 1PH/2W, 2PH/3W, 3PH/3W, and/or 3PH/4W loads.
2. Meters must be capable of directly metering North American 120/208/240v, 277/480V and 347/600V.
3. Metering units must be capable of metering loads between 50A and 5000A. Provide meters specific to each project as indicated on construction drawings.
4. Metering Units may have the capability of paralleling up to 3 (three) sets of CTs per phase. Not applicable to Rogowski coil meters.
5. Must meet all ISO 9001 standards for quality control where all meters test to a minimum of +/- 0.2% or 0.5% accuracy, dependent on stated accuracy class.
6. The system shall be as described below:
 - a. To consist of electronic meters with embedded communications capability, and solid core, split-core or Rogowski coil current transformer technology. The current transformers shall have a full scale output of 0.1A or .333v and secondary voltage clamps for safety purposes.
 - b. Meters to be used for Energy Monitoring and Tenant Billing applications
 - c. The meters will be capable of remote communication from each metering device.
 - d. Standard meters shall have isolated pulse output with output ranges from 10Wh to 1kWh. e. Advanced meters shall transmit data via one of the following communication protocols:
 - i. Isolated Pulse Output

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- ii. Modbus TCP/IP
 - iii. BACNet IP
 - iv. Modbus RTU
 - v. BACNet MS/TP
- f. Backup power provided by on-board battery maintains the real time clock through power loss (Advanced Meters Only). Energy data is stored in non-volatile memory to maintain value through power loss. Device is capable of holding 65 days of historical data in default settings (Advanced Meters Only)
- g. Failure of the building electrical normal power system shall not result in loss of data and will not require manual restarting of the metering system
7. The electronic energy monitoring system shall be fully automated microprocessor-based electrical energy measurement system for Measurement and Verification and Tenant Billing purposes. The system shall incorporate complete metering, communications, reporting functions; energy monitoring and threshold limit capabilities.

2.3 SYSTEM MEASUREMENTS – SINGLE POINT METERING DEVICES

1. Meters to be complete with a Liquid Crystal Display (LCD) to access all energy measurements and phase diagnostics when needed
2. Standard Meter Energy Parameters:
 - a. kWh real consumption
 - b. kW peak resettable kW peak (optional)
3. Advanced Meter Energy Parameters:
 - a. Bi-directional Energy Measurements b. kWh real consumption
 - c. kW peak resettable kW peak
 - d. kW instantaneous consumption
 - e. kVAh apparent energy consumption f. kVA total apparent power
 - g. kVARh reactive consumption h. kVAR total reactive power
 - i. PF power Factor Total
 - j. Maximum kW peak demand with time and date stamp k. Line Frequency Hz
4. Advanced Meter Phase Diagnostics: Parameters to be displayed for each individual phase of each metered load:
 - a. Voltage Phase to neutral or phase to phase
 - b. Amps Instantaneous amperage for each phase
 - c. kW Instantaneous real energy
 - d. PF Power factor
 - e. kVA Instantaneous apparent energy
 - f. KVAR Instantaneous reactive energy

2.4 SYSTEM DESCRIPTION – MULTIPPOINT METERING DEVICES

1. The system shall be as described below:
 - a. To consist of electronic multiple point meters with embedded communications capability, and solid core, split-core or Rogowski coil current transformer technology. The current transformers shall have a full-scale output of 0.1A or .333v A/C outputs and secondary voltage clamps for safety purposes.
 - b. Meters to be used for Power Metering and Energy Monitoring.
 - c. Meters shall be capable of external mounting in a NEMA 1 enclosure or internal mounting in electrical panels or switchgear.
 - d. The meters will be capable of remote communication from each metering device. Each device shall have IP sockets and RS-485 terminals to accommodate data transmission via Modbus RTU, Modbus TCP/IP, BACNet MS/TP, BACNet IP and standard Ethernet. Data shall be transmitted by one or a combination of the following:
 - i. Standard Ethernet interface
 - ii. Ethernet connection to PC or laptop via crossover cable.
 - iii. RS-485 Network-Modbus RTU & BACNet MS/TP
 - e. Systems to have backup storage power to key components so no data is lost during power outages. The system shall continue to function after resumption of power.
 - f. Failure of the building electrical normal power system shall not result in loss of data and will not require manual restarting of the metering system.
2. The electronic energy monitoring system shall be fully automated microprocessor-based electrical energy measurement system for Measurement and Verification and Tenant Billing purposes. The system shall incorporate the following:
 - a. Complete metering
 - b. Communications
 - c. Reporting functions
 - d. Energy monitoring
 - e. Threshold limits capabilities.
3. Meters must be capable of directly metering on board, North American 120/208/240V, 277/480V and 347/600V.
4. Meters may require Potential Transformers in 480v Delta and 347/600v applications.
5. Meters may be capable of two distinct and independent reference voltage inputs to allow for monitoring two separate electrical systems. Meter must allow any CT input to be referenced against either input voltage channel.
6. Metering Units may have the capability of a Wiring Harness, single incoming cable containing 25 pairs of 22 AWG wire with associated current transformers (CT's) or optional Terminal Strips, screw terminal connections for CTs. Metering Units may also be configured with individual input channels for CT's secondary wires.
7. Must meet all ISO 9001 standards for quality control where all meters test to a minimum of +/- 0.2% or 0.5% accuracy, dependent on accuracy class.

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8. Metering unit(s) must be configurable to meter 24 single-pole circuits, 12 two-pole circuits, or 8 three-pole circuits
9. Metering unit (s) must be configurable to meter 48 single pole circuits, 16 two pole circuits or 16 three-pole circuits.
10. Metering unit (s) must be configurable to meter 12 single pole circuits, 4 two-pole circuits or 4 three-pole circuits.

2.5 SYSTEM MEASUREMENTS – MULTIPPOINT METERING DEVICES

1. Meters to be complete with a Liquid Crystal Display (LCD) to access energy measurements and phase diagnostics when needed.
2. Energy Parameters:
 - a. kWh real energy consumption
 - b. kW instantaneous power
 - c. kVAh apparent consumption
 - d. kVA apparent power
 - e. kVARh reactive consumption
 - f. kVAR reactive power
3. Phase Diagnostics: Parameters to be displayed for each individual phase of each metered load:
 - a. Voltage Phase to neutral or phase to phase
 - b. Amps Instantaneous amperage for each phase
 - c. kW Instantaneous power
 - d. PF Power factor
 - e. PA Phase angle
 - f. kVA Instantaneous apparent energy
 - g. KVAR Instantaneous reactive energy
 - h. THD Total Harmonic Distortion-Theta

2.6 METER DATA COLLECTION AND COMMUNICATION

1. Data acquisition sever: Leviton Energy Monitoring HUB
2. Pulse data collection: Leviton High Density Pulse Module
3. Wireless data transmission: Leviton ModHopper

2.7 SYSTEM DESCRIPTION - METER COMMUNICATIONS AND DATA COLLECTION

1. The system shall be as described below:
 - a. To consist of energy management hubs, pulse modules, wireless communication devices, and software used to transmit, collect, and display data provided by sub-metering equipment used to capture measurements from utilities that include, but are not limited to, electrical, gas, water.
 - b. System to allow all data collected to be connected to IP based applications including Third Party Billing Companies/Software, Enterprise Energy Management Software, Demand Response, and

Smart Grid Collection for use in power measurement and tenant billing.

- c. Data collection system shall be all non-proprietary and compatible with industry standard M&V software applications. Open protocols such as Modbus, pulse outputs, analog, resistive inputs, etc. shall be utilized. No proprietary or manufacturer specific protocols between meter and data collectors shall be accepted.

2.8 PRODUCT REQUIREMENTS - DATA ACQUISITION SERVER

1. Provide data acquisition servers that measure and verify data from electrical meters, water and gas meters and other compatible environmental sensors.
2. Server shall comply with the following codes and standards:
 - a. FCC CFR 47 Part 15, Class A
 - b. EN 610000 c.
 - EN 61326 d. CE
3. Server shall be equipped with an ARM7 embedded CPU, an ARM7 I/O co-processor, 32MB of onboard RAM, 16MB of NOR flash memory, and a USB expansion port.
4. Server shall operate under the following conditions:
 - a. 32°F to 122°F (0°C to 50°C), 0-90% RH, non-condensing
 - b. 41°F to 104°F (5°C to 40°C), 0-90% RH, non-condensing
5. Server shall have the capability to collect and log information at intervals from one (1) to sixty (60) minutes.
6. Server shall timestamp all acquired data and store it in a non-volatile memory.
7. Server shall use modem and/or Ethernet connections for internet access allowing either static IP (internet protocol) or DHCP (Dynamic Host Control Protocol) addressing.
8. Server shall communicate with metering data points via wired or wireless connections over the following protocols:
 - a. Wired communications:
 - i. Pulse
 - ii. Ethernet-Modbus TCP/IP
 - iii. RS-485-Modbus RTU
 - a. Modbus devices to be connected via Belden 1120A or equivalent 18g twisted shielded pair.
 - b. Wireless Communications:
 - i. Wireless Modbus
9. Server shall communicate with external devices via -wired or wireless connections over the following protocols:
 - a. Wired communications:
 - i. Ethernet LAN (Local Area Network) or WAN (Wide Area Network)
 - ii. TCP/IP

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- iii. PPP
- iv. HTTP/HTML
- v. FTP vi.
- NTP vii.
- XML viii.
- SNMP
- ix. BACnet-Optional Downloaded Module b.

Wireless Communications:

- i. GSM (Global System for Mobile Communications)
- ii. GPRS (General Packet Radio Service)
- iii. PSTN (Public Switched Telephone Network)

c. Server shall upload data at user selectable scheduled intervals via HTTP or FTP and download data in XML or custom formats.

10. Server shall generate alarms for data points including SNMP (Simple Network Management Protocol) traps.

11. Server shall have the following input and output connections:

a. Input:

- i. RS485 Modbus serial input capable of supporting 32 external devices. Input to be expandable at owner's option.
- ii. Eight (8) Flex I/O inputs configurable for the following modes:
- iii. 0-10VDC
- iv. 4-20mA
- v. Resistive
- vi. Standard KYZ pulse modes for A or C dry contact relay outputs vii. Status

b. Output:

- i. Two (2) opto-FET dry contact relays rated at 30VDC and 150mA maximum

2.9 PRODUCT REQUIREMENTS – HIGH DENSITY PULSE MODULES

1. Provide high density pulse module for collection and distribution of pulse output data generated by electric.
2. Module shall have on-board, adjustable Modbus addressing via dip switches with addresses from 1-128.
3. Module shall comply with the following codes and standards:
 - a. FCC CFR 47 Part 15, Class A emissions standard.
4. Module shall be equipped with an ARM7 I/O processor with field-upgradable firmware.
5. Module shall communicate over a Modbus / RTU RS-485, two wire network with the following network speeds

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- a. 19200 Baud b. 9600 Baud
6. Module shall operate under the following conditions
 - a. -22°F to 158°F (-30°C to 70°C), 0-90% RH, non-condensing
7. Module shall have a 32-bit pulse counter which rolls over at 4.295 billion pulses per channel and store pulse data in a non-volatile memory. Pulse rate shall be user selectable.
8. Module shall have the following input and output connections
 - a. Input
 - i. Non isolated pulse and power inputs
 - ii. Modbus RS485 connection
 - iii. Twenty-three (23) independent pulse count inputs designed for use with dry contact outputs. The pulse rate shall be user selectable between the following:
 - a. 10Hz: Minimum pulse width to be 50ms
 - b. 50Hz: Minimum pulse width to be 10ms
 - c. 100Hz: Minimum pulse width to be 5ms

2.10 PRODUCT REQUIREMENTS – WIRELESS TRANSCEIVER

1. Provide OPTIONAL wireless transceiver for collection and distribution of pulse outputs generated by electrical meters, other energy and water meters and environmental sensors.
2. Transceiver shall comply with the following codes and standards:
 - a. FCC CFR 47 Part 15, Class A emissions standard.
 - b. FCC ID to be OUR-9XTREAM
 - c. Industry Canada ID to be 4214A-9XTREAM
3. Transceiver shall be equipped with a 60 MHz ARM7 embedded CPU.
4. Transceiver firmware to be field upgradable.
5. Transceiver shall communicate over a self-healing, self-optimizing wireless mesh network. Network shall utilize frequency hopping, spread-spectrum radio transmission and reception over 900MHz band.
6. Transceiver shall have a range of 3000 feet indoors and 14 miles outdoor line of sight.
7. Transceiver broadcast power shall be 1 watt.
8. Transceiver shall operate under the following conditions
 - a. 32°F to 122°F (0°C to 50°C), 0-90% RH, non-condensing
 - b. 1.24 miles (2000m) maximum altitude, degree 2 pollution
9. Transceiver shall have a pulse counter with pulse data stored in a non-volatile memory.
10. Transceiver shall have the following input and output connections. Modbus addresses to be adjustable via DIP switches with addresses between 1 and 247.

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- a. Input
 - i. Two (2) Pulse inputs with user selectable pulse rates of 10, 50, 100, or 250 Hz.
 - ii. Modbus RS485 input
 - iii. Connect a maximum of 32 Modbus devices to transceiver input b. Outputs to be user selectable between 100 Ohms and 2.5 kOhms.
 - iv. Two (2) opto-FET dry contact relays rated at 30VDC, 150mA max.

2.11 CLOUD BASED ENERGY INFORMATION SOFTWARE

- 1. Software package shall consist of one or more of the following WEB based system modules:
 - a. Basic Building Management Software: BMO Base Module
 - b. Enterprise Energy Management Software: BMO Advanced Reporting Module
 - c. Tenant Billing Software: BMO Tenant Billing Module

2.12 PRODUCT REQUIREMENTS-BASIC SOFTWARE-BMO BASE MODULE

- 1. BMO Base Module is a basic energy information platform that allows for basic reporting of limited graphing of energy information collected from energy and water meters and environmental sensors.
- 2. Provide a web hosted software platform which is fully functional without software other than standard web browsers including, but not limited to, Microsoft Internet Explorer, Google Chrome and Firefox Mozilla
 - a. Software shall support multiple Leviton Energy Monitoring HUBs/Properties.
 - b. Software shall support unlimited number of meter data points based on subscription level.
- 3. Software shall be used for the collection, analysis, and reporting of energy data from sub-metering equipment used to capture energy usage measurements that include, but are not limited to, electrical, gas, water, steam & BTU values
- 4. Software shall collect and report data in intervals 15 minute intervals by default; other user defined intervals available.
- 5. Software shall produce configurable reports and display data for all engineering units available from the meters incorporated into the system; kWh, kW, gallons, BTU.hr, etc.

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6. Software shall allow for exportable tabular data in all report options; excel, .csv, etc.
7. Software shall allow for graphical representations of data in 15-minute intervals or other intervals as determined by the end user.
8. Software shall allow for the creation of virtual meter points.
9. Platform will allow for the creation of user defined dashboards.
10. Software shall allow for a Date Picking capability to allow for reports to be selected from the following time options:
 - a. Last Hour, 8Hrs, Today, Yesterday, 7 days, Week, 30 days, Month, Last Month, Last 12 Months, This Year, Last Year
 - b. User Defined Custom Period including date and time range as narrow as a single 15 minute interval
11. Report Header will display the range of total available data for the meter assigned to the report
12. Software will allow for the creation of user defined alarms for low and high readings for energy metrics reported on meters within the system.

2.13 PRODUCT REQUIREMENTS – EEM SOFTWARE-BMO ADVANCED REPORTING MODULE

1. Description: BMO Advanced Reporting Module is an Enterprise Energy Management software platform designed to assist energy and facility managers in the conduct of daily energy management reporting and analysis functions. It is designed for portfolio level use incorporating a wide range of graphical interfaces and an executive dashboard for high level energy information.
2. Provide a web hosted software platform which is fully functional without software other than standard web browsers including, but not limited to, Microsoft Internet Explorer, Google Chrome and Firefox Mozilla
3. Software shall support an unlimited number of separate locations/facilities and an unlimited number of data points per facility, based on user subscription level.
4. Software shall allow for unique facility information to be entered on Building Set Up Page to include:
 - a. Facility Address Information
 - b. Facility Square Footage
 - c. Utility Cost Information
5. Software shall be used for the collection, analysis, and reporting of energy data from sub-metering equipment used to capture energy usage measurements that include, but are not limited to, electrical, gas, water, steam & BTU values
6. Software shall collect and report data in intervals 15-minute intervals by default; other user defined intervals available.

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7. Software shall produce configurable reports and display data for all engineering units available from the meters incorporated in to the system; kWh, kW, gallons, BTU.hr, etc.
8. Software shall allow for exportable tabular data in all report options; excel, .csv, etc.
9. Software shall allow for a wide variety of graphical representations of data in the following options:
 - a. Line Charts
 - b. Bar Charts
 - c. Area Charts
10. Software shall allow for graphical data to be displayed in the following time interval options:
 - a. 15 minute
 - b. One day
 - c. One week
 - d. One month
 - e. One year
 - f. Custom User Defined Interval
11. Software shall allow for a Date Picking capability to allow for reports to be selected from the following time options:
 - a. Last Hour, 8Hrs, Today, Yesterday, 7 days, Week, 30 days, Month, Last Month, Last 12 Months, This Year, Last Year
 - b. User Defined Custom Period including date and time range as narrow as a single 15 minute interval
12. Report Header will display the range of total available date for the meter or virtual meter assigned to the report. Will also make tabular data available via selector tool.
13. Software shall organize all user defined and pre-configured reports to be cataloged on a building specific dashboard including the following basic information:
 - a. Street Map pinpointing the buildings geographic location
 - b. Local current weather conditions displayed
14. Software shall allow for the construction of Virtual Meters with the following parameters:
 - a. Any number of like kind data points (kWh + kWh, etc)
 - b. Combinations of data points from any HUB found in the software license
 - c. Combinations of virtual meters to create an additional virtual meter.
 - d. Virtual meter point data begins on the date and time the VM is created.
15. Software shall allow the creation of energy information alerts with the following parameters:
 - a. Alerts shall be either consumption or demand based
 - b. Alerts shall be based on high and low limits configured by end user.
 - c. Alerts will be configured to allow communications via the following methods:
 - i. Text
 - ii. Email

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16. Software shall allow for the creation of configurable Kiosks for public display of Energy Information.
Energy data configured for display will be updated every 15 minutes or at other user defined intervals.
17. Software will allow for the following specific report types for advanced reporting and analytics:
 - a. After Hours Consumption Reporting
 - b. Drift Analysis
 - c. Multi-Utility Parameter Report
 - d. Electric Service Tree Report-Power Distribution Mapping
 - e. Daily Heat Map-Energy Intensity
 - f. Hourly Heat Map-Energy Intensity
 - g. Rate Schedule Builder
18. BMO Base module functionality will be enabled in conjunction with this module.

PART 3 - EXECUTION

3.1 WIRING AND CONNECTIONS

1. All wiring must meet and or exceed local electrical code.
2. Metering points show on submitted drawings only to be connected or installed
3. Install all wiring in conduit.
4. Provide a non-dedicated or Ethernet drop for remote meter reading and diagnostics of the system
5. Perform all necessary system calibration, testing, commissioning, and demonstrations as required
6. Prepare and submit record drawings and installation, operation and maintenance manuals for the energy management system as required.

3.2 TESTING AND COMMISSIONING

1. Perform final testing, adjustment, and commissioning of the systems, report results to the Consultant, and include the results in the installation, operation, and maintenance manuals. Provide qualified technicians for testing and commissioning.
2. Perform sufficient technical and operational tests to ensure the technical performance of the system meets the intent of the Contract Documents. Typical testing to include but not be limited to:
 - a. Verification of meter readings and proper installation of meter equipment
 - b. Communication system connectivity
 - c. Meter communication with all software platforms
3. Provide optional functional testing including end to end verification that all meters are operating properly.
4. Demonstrate the operation of the system to the Owner at a time suitable to them. Such demonstration to include product training on how to program the monitoring system.

3.3 FIELD VERIFICATION, ACCEPTANCE, AND TRAINING

1. Provide all “AS BUILT” DRAWINGS and data showing each meter, serial number, address, cross reference, load and CT ratio prior to field verification.
2. Manufacturer’s representative shall verify, adjust and test the system. Verification of the energy monitoring system is to be carried out with the assistance of an electrical contractor at all times. Upon completion, the manufacturer shall issue a “Commissioning Report” to the owner, electrical consultant, contractor and client.
3. Manufacturer’s representative shall demonstrate operation of the system as follows:
 - a. Local and remote meter readings
 - b. Phase diagnostics
 - c. Provide manual of the installed system
 - d. Ensure system is connected to the cloud as required to communicate with software servers.
4. Software training is typically completed remotely via on-line instruction by Leviton technical support.

3.4 FIELD QUALITY CONTROL

1. Submit a detailed testing and commissioning procedure to the Consultant and Client for review and approval prior to undertaking this Work. The procedure shall indicate all test equipment required and acceptance criteria.
2. Upon completion of all testing and commissioning, submit a copy of the test results and certify the system as acceptable for revenue metering purposes.
3. Undertake the testing and commissioning Work with the manufacturer’s factory representative(s).

3.5 INSTRUCTION TO STAFF

1. Upon completion of the installation, a competent instructor representing the system manufacturer shall provide a lecture to the operating and maintenance staff concerning the intent, use, and operation and maintenance of the system. This may be accomplished remotely.

END OF SECTION 26 09 13

SECTION 26 09 19 - ENCLOSED CONTACTORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Lighting contactors.

1.2 RELATED REQUIREMENTS

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 2813 - Fuses.

1.3 REFERENCE STANDARDS

- A. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
- B. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (R2011).
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide dimensions, size, voltage ratings and current ratings.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation.
- B. General Electric Company.
- C. Schneider Electric; Square D Products.

2.2 LIGHTING CONTACTORS

- A. Description: NEMA ICS 2, magnetic lighting contactor.
- B. Configuration: Electrically held.
- C. Coil operating voltage: 120 volts, 60 Hertz.
- D. Poles: As required to match circuit configuration and control function.
- E. Contact Rating: Match branch circuit overcurrent protection, considering derating for continuous loads.
- F. Enclosure: NEMA ICS 6, Type 1.

2.3 ACCESSORIES

- A. Auxiliary Contacts: NEMA ICS 2, 2 normally open contacts in addition to seal-in contact.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install enclosed contactors where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed contactors plumb. Provide supports in accordance with Section 26 0529.
- C. Identify enclosed contactors in accordance with Section 26 0553.

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3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform applicable inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION 26 09 19

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Occupancy sensors.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 37 - Boxes.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 09 19 - Enclosed Contactors: Lighting contactors.
- E. Section 26 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
- F. Section 26 51 00 - Interior Lighting.
- G. Section 26 56 00 - Exterior Lighting.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2014.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.
- E. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install lighting control devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Field Quality Control Reports.
- D. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data: Include detailed information on device programming and setup.
- F. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

LIGHTING CONTROL DEVICES

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- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all occupancy sensors.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

2.2 TIME SWITCHES

- A. Manufacturers:
 - 1. Intermatic, Inc
 - 2. Tork, a division of NSI Industries LLC
- B. Digital Electronic Time Switches:
 - 1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
 - 2. Program Capability:
 - a. Astronomic Time Switches: Four channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
 - 3. Schedule Capacity: Not less than 16 programmable on/off operations.
 - 4. Provide automatic daylight savings time and leap year compensation.
 - 5. Provide power outage backup to retain programming and maintain clock.
 - 6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
 - 7. Input Supply Voltage: Multiple voltage input for 120, 208, 240 or 277 V ac.
 - 8. Output Switch Configuration: SPDT dry unpowered momentary contacts.
 - 9. Output Switch Contact Ratings:
 - a. Resistive Load: Not less than 30 A at 120-277 V ac.
 - b. Inductive Load: Not less than 30 A at 120-277 V ac.
 - c. Ballast Load: Not less than 20 A at 120 V ac or 6 A at 277 V ac.
 - d. Motor Load: Not less than 1 HP at 120 V ac or 2 HP at 240 V ac.
 - 10. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:
 - a. Indoor clean, dry locations: Type 1.

2.3 OUTDOOR PHOTO CONTROLS

- A. Manufacturers:
 - 1. Intermatic, Inc
 - 2. Tork, a division of NSI Industries LLC
- B. Stem-Mounted Outdoor Photo Controls:
 - 1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.

2. Housing: Weatherproof, impact resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Provide external sliding shield for field adjustment of light level activation.
5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
6. Voltage: As required to control the load indicated on the drawings.
7. Failure Mode: Fails to the on position.
8. Load Rating: As required to control the load indicated on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130 , including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 37 as required for installation of lighting control devices provided under this section.
- C. Where indicated or required, provide cabinet or enclosure in accordance with Section 26 05 37 for mounting of lighting control device system components.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Coordinate with Owner for time clock programming and perform programming.
- D. Test time switches to verify proper operation.
- E. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust photoelectric switches to point north and adjust as required.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- B. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

- C. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
 - 4. Location: At project site.

END OF SECTION 26 09 23

SECTION 26 09 43 – NETWORKED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. System Software Interfaces.
2. System Backbone and Integration Equipment.
3. Wired Networked Devices.
4. Wireless Networked Devices.

B. Related Requirements:

1. Div. 26: Section 260500 "Common Work Results for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 262726 "Wiring Devices" for wired switches and dimmers and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. Data Bus: A wired interface used to communicate with connected devices.
- B. Device: A collective term for bus or wireless connected devices, including fluorescent ballasts, LED drivers, incandescent luminaires, manual switches, switching relays, sensors, and similar.
- C. Global: Communication between devices in otherwise separate spaces using a bridging device or system controller.
- D. Group: A set of devices that communicate together.
- E. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- F. Scene: Digital light level associated with a preset.
- G. System Backbone: Devices used to connect and manage otherwise separate spaces, including bridging devices and gateways or system controllers. Used to expose devices to software configuration via TCP/IP.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference

B. Preinstallation Coordination Meeting(s): For digital-network lighting controls. Conduct meeting(s)

1. Attendees: Installers, fabricators, representatives of manufacturers, and administrators for field tests and inspections.
2. Engage factory-authorized service representative to attend preinstallation conference and review the submittal drawing, sequence of operation, and device installation best practices with Project team.

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3. Engage factory-authorized service representative to perform cellular signal strength measurements during site walk through and compare to Project plans to verify the placement of cellular antennas and quantity of lighting control system RF access points.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Bill of Materials necessary to install the networked lighting control system.
2. Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
3. Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems.
4. Other Diagrams and Operational Descriptions - as needed to indicate system operation or interaction with other system(s).

B. Shop Drawings:

1. Riser Diagrams showing device wiring connections of system backbone and typical per room/area type.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor Startup/Commissioning Worksheet.

B. Service Specification Sheets indicating general service descriptions, including startup, training, post-startup support, and service contract terms.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Contracts:

1. Hardware and Software Operation Manuals
2. Maintenance service agreement.
3. Software service agreement.

B. Warranty documentation.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Phone Support: Toll-free technical support available from manufacturer through an online tool to schedule a technical support appointment and provide 24/7 emergency support.
2. Remote Support: Manufacturer capable of providing remote support and ability to virtually connect with customers to address issues with visual guidance overlaid on images of real-world objects.
3. On-Site Support: Manufacturer capable of providing a 72-hour, on-site response time within the continental United States.

4. Service Contracts: Manufacturer capable of providing service contracts for continued on-site and remote support of the lighting control system post-installation for terms up to 10 years from substantial completion, including:
 - a. Remote and on-site emergency response.
 - b. Remote system performance checks.
 - c. Remote diagnostics.
 - d. Replacement parts.

1.8 WARRANTY

- A. Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control hardware.
 - b. Faulty operation of lighting control firmware.
 2. Minimum Warranty Period: Five years from date of shipment.

PART 2 - PRODUCTS

2.1 SYSTEM COMPLIANCE

- A. System components manufactured in accordance with UL 916 and UL 924 standards where applicable.
- B. System components manufactured in accordance with CFR Title 47, Part 15 standards where applicable.
- C. System components manufactured in accordance with ISED Canada RSS-247 standards where applicable.
- D. System components manufactured in accordance with IFT-008-2015 and NOM-208-SCFI-2016 standards where applicable.
- E. System listed as qualified under DesignLights Consortium Networked Lighting Control System Specification v5.0.
- F. Performance Criteria:
 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

2.2 SYSTEM PERFORMANCE REQUIREMENTS

- A. System Architecture:
 1. System architecture based upon the following concepts:
 - a. Networkable intelligent lighting control devices.

- b. Standalone lighting control zones using distributed intelligence.
 - c. Optional system backbone for remote, time-based, and global operation.
2. Intelligent lighting control devices with individually addressable network communication capability and having one or more basic lighting control components including: occupancy sensor, photosensor, relay, dimming output, contact closure input, analog 0-10 V(dc) input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure is permissible to minimize overall system device count.
 3. System capable of interfacing directly with networked luminaires such that either low-voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches, and system backbone.
 4. Networked luminaires and intelligent lighting control devices support individual (unique) configuration of device settings and properties, with such configuration residing within the networked luminaires and intelligent control devices.

5. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices capable of providing automatic control from sensors (occupancy and/or photosensor) and manual control from local wall stations without requiring connection to a higher-level system backbone.
 - a. Lighting control zones (wired and wireless) support at least 128 devices per zone.
 - b. Capable of being networked with a higher-level system backbone to provide time-based control, control from inputs or systems external to control zone, and remote configuration and monitoring through a software interface.
6. Networked luminaires and intelligent lighting control devices with distributed intelligence programming stored in non-volatile memory, such that following any loss of power the lighting control zones operate according to their defined default settings and sequence of operations.
7. System to include one or more system controllers that provide time-based control.
8. System controller provides means of connecting the lighting control system to a system software interface and building management systems via BACnet/IP or BACnet MS/TP protocol.
9. System controller supports both low voltage wired and wireless RF communication within a single controller device.
10. System devices support firmware update, either remotely or from within the application space, for purposes of upgrading functionality at a later date.
11. System capable of reporting lighting system events and performance data to management software for display and analysis.
12. Networked control devices suitable for control of egress or emergency light sources without additional, externally mounted UL 924 shunting or 0-10 V(dc) disconnect devices, to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. Capable of supporting the following sequence of operation:
 - a. Low-Voltage Power Sensing: Devices automatically provide 100 percent light level upon detection of loss of power sensed via low-voltage network cable connection where applicable.
 - b. Line-Voltage Power Sensing: Devices listed as UL 924 emergency relays which automatically close load-control relay and provide 100 percent light output upon detection of loss of power sensed via line voltage connection to normal power.
13. Global Control Zones: Networked luminaires and intelligent lighting control devices located in different areas able to transmit and track information within at least 128 system-wide control zones to support required sequences of operation that may span multiple areas. Occupancy, photosensor inhibit, and switch commands available across multiple controllers.

14. Wired Networked Wall Station Scene-Control Capabilities:
 - a. Preset Scenes that activate a specific combination of light levels across multiple local and global channels.
 - b. Local Profile Support: Profile Scenes that modify the sequence of operation for devices in the area (group) in response to a button press to dynamically optimize occupant experience and lighting energy usage.
 - 1) Wall stations able to manually start and stop local profiles, or local profile capable of ending after a specific duration of time between five minutes and 12 hours.
 - 2) Configurable Parameters:
 - a) Fixture light level.
 - b) Occupancy time delay.
 - c) Response to occupancy sensors (including enabling/disabling response).
 - d) Response to daylight sensors (including enabling/disabling response).
 - e) Enabling/disabling wall stations.
 - c. Three-Way or Multi-Way Control: Multiple wall stations capable of controlling the same local and global control zones, to support "multi-way" preset scene and profile scene control.

B. System Integration Capabilities:

1. Capable of interface with third-party building management systems (BMS) to support two-way communication using BACnet/IP protocol, BACnet MS/TP protocol, and RESTful API including the following system integration capabilities:
 - a. "Write" messages for control of individual devices, including control of relay and dimming output.
 - b. "Write" messages for control of groups of devices through a single command, including control of relay and dimming output of all devices.
 - c. "Read" messages for individual device status information.
 - 1) Available status will vary based on device type and capabilities, which may include relay state, dimming output, power measurement, occupancy sensor status, and photosensor light measurement.
 - d. "Read" messages for group status information for occupancy, relay state, and dimming output.
 - e. Activation of pre-defined system Global Profiles.
2. Activation of Global Profiles from third-party systems via dry contact closure output signals or digital commands via RS-232 or RS-485.
3. Activation of demand response levels from Demand Response Automation Servers (DRAS) via OpenADR 2.0a protocol.

C. Supported Sequence of Operations:

1. Control Zones:
 - a. Local Control Zones: Networked luminaires and intelligent lighting control devices installed in an area (also referred to as a group of devices) capable of transmitting and tracking occupancy sensor, photosensor, and manual switch information within at least 48 unique control zones to support different and reconfigurable sequences of operation within area. These will also be referred to as local control zones.
 - b. Adjacent Control Zones: Networked luminaires and intelligent lighting control devices capable of tracking occupancy broadcasts from adjacent zones. When this feature is enabled, luminaire output for a vacant zone will reduce to a configurable dimmed state if one or more adjacent zones are occupied. Luminaires will turn off when both primary and adjacent zones are vacant.
 - c. Global Control Zones: Networked luminaires and intelligent lighting control devices located in different areas able to transmit and track information within at least 128 system-wide control zones to support required sequences of operation that may span across multiple areas. Occupancy, photosensor inhibit, and switch commands available across multiple controllers.
 - d. Wall stations support the following capabilities:
 - 1) On/Off of a local or global control zone.
 - 2) Continuous dimming control of light level of a local or global control zone.
 - e. Multi-Way Control: Multiple wall stations capable of controlling the same local or global control zones, to support "multi-way" switching and dimming control.
2. Occupancy Sensing Capabilities:
 - a. Occupancy sensors configurable to control a local or global zone.
 - b. Multiple occupancy sensors capable of controlling the same local or global zones. This capability combines occupancy sensing coverage from multiple sensors without consuming multiple control zones.

- c. Occupancy sensing sequence of operation modes:
 - 1) On/Off Occupancy Sensing.
 - 2) Partial-On Occupancy Sensing.
 - 3) Partial-Off Occupancy Sensing.
 - 4) Vacancy Sensing (Manual-On / Automatic-Off).

- d. On/Off, Partial-On, and Partial-Off Occupancy Sensing Modes Sequence of Operation:
 - 1) Occupancy automatically turn lights on to a designated level when occupancy is detected. Designated occupied light level support at least 100 dimming levels.
 - 2) Occupancy sensors automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. Designated unoccupied dim level support at least 100 dimming levels.
 - 3) System capable of combining Partial-Off and Full-Off operation by dimming lights to a designated level when vacant and turning the lights off completely after an additional time delay.
 - 4) Photosensor readings, if enabled in occupancy sensing control zone, automatically adjust light levels during occupied or unoccupied conditions as necessary.
 - 5) Wall station activation changes the dimming level or turn lights off as selected by the occupant. Lights optionally remain in this manually specified light level until the zone becomes vacant. Upon vacancy, normal sequence of operation resumes.

- e. Vacancy Sensing or Manual-On/Automatic-Off Mode Sequence of Operation:
 - 1) Activation of a wall station is required turn lights on. System capable of programming the zone to turn on to either a designated light level or previous user-set light level. Initially occupying the space without using a wall station must not result in lights turning on.
 - 2) Occupancy sensors automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. Designated unoccupied dim level support at least 100 dimming levels.
 - 3) System capable of dimming the lights when vacant and then turning the lights off completely after an additional time delay.
 - 4) System capable of an "automatic grace period" immediately following detection of vacancy, during which time any detected occupancy results in the lights reverting to the previous level. After the grace period has expired, the use of a wall station is required to turn lights on.
 - 5) Photosensor readings, if enabled in the Occupancy Sensing control zone, capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary.
 - 6) Wall station interaction changes the dimming level or turn lights off as selected by occupant. Lights remain at manually specified light level until zone becomes vacant; normal sequence of operation resumes upon vacancy.
 - f. Occupancy time delays before dimming or shutting off lights separately programmable for all control zones from 15 seconds to 2 hours.
3. Photosensor Sensing Capabilities (Automatic Daylight Sensing):
- a. Photosensor devices configurable to control a local zone.
 - b. Photosensor-Based Control:
 - 1) Continuous Dimming: Control zone automatically adjusts dimming output in response to photosensor readings, to maintain a minimum light level consisting of both electric light and daylight sources. Photosensor response configurable to adjust set point and dimming rates.
4. Schedule Capabilities:
- a. System capable of time schedules for time-of-day to override devices including offsets from dusk and dawn.
 - b. System capable of providing a visible "blink warning" five minutes prior to the end of the schedule.
 - c. Wall stations may be programmed to provide timed extensions/overrides that turn the lights on for an additional time period.
 - 1) Timed override/extension duration programmable for each individual device, zone of devices, or customized group of devices, from five minutes to 12 hours.

5. Global Profile Capabilities:
 - a. System capable of automatically modifying the sequence of operation for selected devices in response to any of the following:
 - 1) Time-of-day schedule.
 - 2) Contact closure input state.
 - 3) Manually triggered wired wall station input.
 - 4) RS-232/RS-485 command to wired input device.
 - 5) BACnet input command.
 - b. Global Profile Capabilities:
 - 1) Global Profiles stored within and executed from the system controller (via internal timeclock). Dedicated software host or server is not required to be online to support automatic scheduling and/or operation of Global Profiles.
 - 2) Global Profile time-of-day schedules capable of recurrence settings including daily, specific days of week, every "n" number of days, weekly, monthly, and yearly. Lighting control global profile schedules support definition of start date, end date, end after "n" recurrences, or never ending.
 - 3) Daylight savings time adjustments capable of being performed automatically, if desired.
 - 4) Global Profile holiday schedules follow recurrent settings for specific U.S. holiday dates regardless if they always occur on a specific date or are determined by day/week of the month.
 - 5) Global Profiles capable of being scheduled to run according to timed offsets relative to sunrise or sunset. Sunrise/sunset times automatically derived from location information using an astronomical clock.
 - 6) Software management interface capable of displaying a graphic calendar view of profile schedules for each control zone.
 - 7) Global Profiles capable of manual activation directly from system controller, specially programmed wired input devices, scene-capable wired wall stations, and software management interface.
 - 8) Global Profiles selectable to apply to a single device, zone of devices, or customized group of devices.
 - 9) Global Profile Configurable Parameters:
 - a) Fixture light level.
 - b) Occupancy time delay.
 - c) Response to occupancy sensors (including enabling/disabling response).
 - d) Response to daylight sensors (including enabling/disabling response).
 - e) Enabling/disabling of wall stations.
 - c. Local and Global Profiles backed up and stored on software's host server such that Profile backup can be applied to a replacement system controller or wired wall station.
6. System supports automated demand response capabilities with automatic reduction of light level to at least three levels of demand response, configurable for each output device.

2.3 SYSTEMS SOFTWARE INTERFACES

A. Management Interface:

1. Web-based management interface for remote system control, live status monitoring, and configuration of lighting control settings and schedules.
 2. Compatible with industry-standard web browser clients.
 3. Minimum of 100 unique password-protected user accounts.
 4. Minimum of three user permission levels: read-only, read and change settings, and full administrative system access.
 5. Capable of restricting access for user accounts to specific devices within the system.
 6. All system devices capable of being given user-defined names.
 7. Device identification information displayed in the Management interface including:
 - a. Model number.
 - b. Model description.
 - c. Serial number or network ID.
 - d. Manufacturing date code.
 - e. Custom label.
 - f. Parent network device.
 8. Management interface capable of displaying live status of a networked luminaire or intelligent control device including:
 - a. Luminaire on/off status.
 - b. Dim level.
 - c. Power consumption.
 - d. Device temperature.
 - e. PIR occupancy sensor status.
 - f. Microphonic occupancy sensor status.
 - g. Remaining occupancy time delay.
 - h. Photosensor reading.
 - i. Active Profiles.
 9. Management interface capable of displaying and modifying the current active settings of a networked luminaire or intelligent control device including:
 - a. Dimming trim levels.
 - b. Occupancy sensor and photosensor enable/disable.
 - c. Occupancy sensor time delay and light level settings.
 - d. Occupancy sensor response (normal or vacancy).
 - e. Photosensor setpoints and transition time delays.
 10. Management interface capable of applying settings changes for a zone of devices or a group of selected devices using a single action that does not require the user to apply settings changes for each individual device.
 11. Management interface capable of compiling a printable network inventory report.
 12. Management interface capable of compiling a printable report detailing all system profiles.
 13. All sensitive information stored encrypted.
 14. System software updates available for automatic download and installation via the Internet.
- B. System Energy Analysis and Reporting:
1. Intuitive graphical screens to facilitate simple viewing of system energy performance.
 2. Energy Scorecard: Summarized display that indicates calculated energy savings in dollars or KWh.
 3. Software calculates allocation of energy savings by control measures including occupancy sensors, photosensors, and manual switching.
 4. Energy savings data calculated for the system as a whole.
 5. Time-scaled graph showing all relay transitions.
 6. Time-scaled graph showing zone occupancy time delays.

7. Time-scaled graph showing the total light level.
8. Software capable of storing information remotely onto an open-source, object-relational database, such as PostgreSQL.
9. Data stored in the database will be accessed utilizing an open standard, application programming interface, such as Open Database Connectivity (ODBC).

C. Visualization and Programming Interfaces:

1. System provides an optional web-based visualization interface that displays a graphical floorplan.
2. Graphical floorplan will offer the following types of system visualization:
 - a. Full Device Option: Master graphic of entire building, by floor, showing each control device installed with zones outlined including:
 - 1) Controls embedded light fixtures.
 - 2) Controls devices not embedded in light fixtures.
 - 3) Daylight sensors.
 - 4) Occupancy sensors.
 - 5) Wall switches and dimmers.
 - 6) Scene controllers.
 - 7) Networked relays.
 - 8) Wired bridges.
 - 9) System Controllers.
 - 10) Wired relay panels.
 - 11) Group outlines.
 - b. Group-Only Option: Master graphic of the entire building, by floor, showing only control groups outlined.
 - c. Pan and zoom commands supported to allow smaller areas to be displayed on a larger scale simply by panning and zooming each floor's master graphic.

- d. Selecting any control device displays the following as applicable:
 - 1) Device catalog number.
 - 2) Device name and custom label.
 - 3) Device diagnostic information.
 - 4) Link to further information on device including status or current configuration.
 3. Programming capabilities through the application will include the following:
 - a. Switch, occupancy sensor, and photosensor zone configuration.
 - b. Manual-on or automatic-on modes.
 - c. Turn-on and dim to dimming levels.
 - d. Occupancy sensor time delays and PIR sensitivity.
 - e. Dual technology occupancy sensors sensitivity.
 - f. Photosensor calibration adjustment and auto-setpoint.
 - g. Multiple photosensor zone offset.
 - h. Trim level settings.
 - i. Preset scene creation and copy for scene-capable devices.
 - j. Application of custom device labels to the Bluetooth Low-Energy Programming Devices and individual connected lighting control devices.
 - k. Fade rate settings.
- D. Smartphone Programming Interface for Wired and Wireless Devices:
1. Interface provided for both Apple iOS and Android operating systems that allows configuration of lighting control settings.
 2. Application supports configuration of wireless networked control devices.
 - a. Application access granted with valid user name and password.
 - b. Access to program information governed by permission system that allows users to share access with other users and restrict access to those who should not be able to reconfigure the equipment.
 - c. Indication of signal strength where multiple Bluetooth Low-Energy Programming Devices are available for configuration.
 3. Application supports configuration of wired networked control devices.
 - a. Connected device access granted through user-defined passcode at initial install.
 - b. Indication of signal strength where multiple Bluetooth Low-Energy Programming Devices are available for configuration.
 4. Programming Capabilities:
 - a. Switch, occupancy sensor, and photosensor group configuration.
 - b. Manual-on or automatic-on modes.
 - c. Turn-on and dim to dimming levels.
 - d. Occupancy sensor time delays and PIR sensitivity.
 - e. Dual technology occupancy sensors sensitivity.
 - f. Photosensor calibration adjustment and auto-setpoint.
 - g. Multiple photosensor zone offset.
 - h. Trim level settings.
 - i. Preset scene creation.
 - j. Application of custom device labels for individual connected lighting control devices.
 - k. Fade rate settings.

2.4 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

- A. System Controller: Multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nECY or comparable product by one of the following:
 - a. Cooper Lighting Solutions, LLC.
 - b. Leviton Manufacturing Co., Inc.
 2. System Controller Processor: 32-bit microprocessor operating at a minimum of 1 GHz.
 3. System Controller Memory: Minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support operating system and databases.
 4. System Controller Functions:
 - a. Time-based control of downstream wired and wireless network devices.
 - b. Linking into an Ethernet network.
 - c. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
 - d. Connection to various software interfaces, including management interface, historical database and analytics interface, and visualization interface.
 5. Integral web server to support system controller configuration and diagnostics.
 - a. Web Server Control Interface:
 - 1) Display associated devices within the context of a graphical floorplan.
 - 2) Provide control of output-capable devices through virtual sliders, toggle buttons, preset level widgets, and transparent layers on floorplan.
 - 3) Control Capabilities:
 - a) Control of individual output devices, including control of relay state and analog dimming level where applicable.
 - b) Control of local lighting control zones, including control of relay state and analog dimming level where applicable.
 - c) Control of global lighting control zones, including control of relay state and analog dimming level where applicable.
 - d) Control of Global Profiles.
 - b. Visualization Interface:
 - 1) Customizable display with the ability to superimpose colored, transparent layers representing real-time property values, including occupancy status, dimming level status, light level status, and online or offline status where applicable.
 - 2) Ad hoc display of trended information via an intuitive values-over-time graph.
 - 3) Report Creation:
 - a) Reports accept and graphically display trended status datasets for creator selected devices or zones of devices.
 - b) Report information displayed over a user-defined interval and date range.
 - c) Reports exportable to a standard CSV format.
 6. Graphical touch screen to support configuration and diagnostics.
 7. Minimum of three RJ-45 networked lighting control ports for connection to any of the following:

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- a. Graphical touch screen.
 - b. Wired communication bridges.
 - c. Direct connection to networked wired luminaires and intelligent lighting control devices (up to 128 total devices per port).
8. Device will automatically detect all network-connected devices.
9. Capable of managing and operating a minimum of 750 networked devices (wired or wireless) per system controller.
10. Multiple System Controllers capable of connection via LAN for scalability to a minimum of 20,000 networked devices.
11. Supports BACnet/IP and BACnet MS/TP protocols to directly interface with BMS and HVAC equipment without additional protocol translation gateways.
 - a. BACnet MS/TP Connection Speed: 9600 to 115200 baud rate.
 - b. BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
12. Integral FIPS 140-2, Level 1 cryptographic module.
13. Supports RESTful API for control of BACnet objects, user management, date and time, and file management.
14. NEMA 1 enclosure with Class 1 and Class 2 separation.
 - a. Power Supply Voltage: 120 to 277 V(ac).
15. Automatic algorithm to eliminate redundant, wireless networked paths to streamline communication between the system controller and end devices.
16. System Controller Security Provisions:
 - a. Disallow the use of default passwords and require passwords to be updated prior to use.
 - b. Support user role-based access, such as administrator, user, and viewer.
 - c. Signed firmware to ensure that unmodified, authentic software is always installed.
 - d. IP-based communication protected with strong encryption algorithms such as AES or TLS1.2+.
 - e. Prevent rollback of firmware to firmware versions with known, critical vulnerabilities.
 - f. Valid cybersecurity listing through a third party.
17. Cellular Remote Access: Cellular router and modem for remote access.
 - a. Router supports remote access to at least five system controllers on its local area network or network subnet.
 - b. Remote access capable of device setting updates, schedule updates, system performance optimization, and diagnostics.
 - c. Remote access enabled through outbound communication from router to an outside source. Solutions that begin communication via inbound requests for network access are unacceptable.
 - d. Router supports outbound communication to manufacturer-hosted portal using TLS1.2 or greater in-transit encryption over a cellular or Ethernet connection.
 - e. Router with integral firewall to prevent unauthorized access to devices connected to its local area network port.
 - f. Router includes cellular SIM capable of connection to AT&T, T-Mobile, Sprint, US Cellular, Alaska Wireless, Telefonica, Tellus, Bell, or Sasktel networks where carrier service is available.
 - g. Outbound communication from the router limited to whitelisted endpoints. Devices that allow unrestricted communication are unacceptable.
 - h. Outbound communication from router includes only lighting control system information.

2.5 WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Dimmers, Scene Controllers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; [nPODM] [nPODM xS] [nPODM xL] [nPODMA] [nPODMA xS] [nPODMA xL] or comparable product by one of the following:
 - a. Cooper Lighting Solutions, LLC.
 - b. Leviton Manufacturing Co., Inc.
2. Mounting: Suitable for installation in single-gang switch box.
3. Communication and low-voltage power delivered via standard low-voltage network cabling with RJ-45 connectors.
4. All switches detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
5. Devices with mechanical push buttons provide tactile and LED user feedback.
6. Devices with mechanical push buttons manufactured with custom button labeling.
7. Wall switch and dimmer options:
 - a. Number of control zones: [1] [2] [4].
 - b. Control Types Supported:
 - 1) On/Off.
 - 2) On/Off/Dimming.
 - 3) On/Off/Dimming/Correlated Color Temperature Control for specific luminaire types.
 - c. Color: [Ivory] [White] [Light Almond] [Gray] [Black] [Red].
8. Scene Controller Options:
 - a. Number of Scenes: [1] [2] [4].
 - b. Control Types Supported:
 - 1) On/Off.
 - 2) On/Off/Dimming.
 - 3) Preset Level Scene Type.
 - 4) On/Off/Dimming/Preset Level for Correlated Color Temperature.
 - 5) Reprogramming of other devices within daisy-chained zone to implement user-selected lighting scene including manual start/stop from the scene controller, or optionally programmed automatic stop after a user-selectable duration between five minutes and 12 hours.
 - 6) Selecting a lighting profile to be run by device's upstream controller to implement a selected lighting profile across multiple zones including manual start/stop from the scene controller, or optionally programmed automatic stop after a user selectable duration between five minutes and 12 hours.
 - c. Color: [Ivory] [White] [Light Almond] [Gray] [Black] [Red].

B. Networked Graphic Wall Stations:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nPOD TOUCH or comparable product by one of the following:
 - a. Cooper Lighting Solutions, LLC.
 - b. Leviton Manufacturing Co., Inc.

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2. Mounting: Suitable for installation in single-gang switch box.
3. Integral 3.5-inch capacitive full-color touch screen.
4. Power via polarity insensitive Class 2 low-voltage 15 to 24V (dc) power supply.
5. Device enables mobile application control of control zones and scenes through Bluetooth.
6. Communication over standard low-voltage network cabling with RJ-45 connectors.
7. User-customizable screen saver utilizing uploaded image file in common file format including jpg, png, gif, bmp, or tif.
8. Capable of configuration of all switches, dimmers, control zones, and lighting preset scenes via password-protected setup screens.
9. Graphic Wall Station Options:
 - a. Number of Control Zones: Up to 16.
 - b. Number of Scenes: Up to 16.
 - c. Profile Scene Duration: User configurable from five minutes to 12 hours.
 - d. Color: [White] [Black].

C. Digital Time Clock:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nDTC or comparable product by one of the following:
 - a. Cooper Lighting Solutions, LLC.
 - b. Leviton Manufacturing Co., Inc.
2. Controls a linear bus of lighting devices supplying all time functions without connection to a system controller.
 - a. Programming of the linear bus of lighting devices must not require additional hardware, including computers, specialized dongles, or other connection devices.
 - b. Programming of the linear bus exclusively done through the touch-screen interface.
3. Capable of up to 32 schedules. Each schedule consists of one set of On and Off times per day for each day of the week and for each of two holiday lists. Schedules assignable to any individual relay or group of relays.
4. Operates from non-volatile memory so that all system programming is retained indefinitely.
5. Mounted inside a relay panel to eliminate the necessity for additional enclosures for complete installation.
6. Capacitive 3.5-inch, full-color touch screen.

D. Wired Networked Digital Key Switches:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nPODA KEY [MNTN] or comparable product by one of the following:
 - a. Cooper Lighting Solutions, LLC.
 - b. Leviton Manufacturing Co., Inc.
2. Mounting: Suitable for installation in single-gang switch box.
3. Communication and low-voltage power delivered via standard low-voltage network cabling with RJ-45 connectors.
4. All switches detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
5. LED user feedback to provide indication of on/off status of the programmed lights or scene, as well as indication of device power.
6. Digital Key Switch Options:
 - a. Control Types Supported:

- 1) On/Off.
- 2) On/Off/Dimming.
- 3) Preset Level Scene Type.
- 4) On/Off/Dimming/Preset Level for Correlated Color Temperature.
- 5) User-programmed local lighting scene run within a daisy-chained group including manual start/stop from the switch, or optionally programmed automatic-stop after a user-selectable duration between five minutes and 12 hours.
- 6) User-programmed global lighting profile run by an upstream controller across multiple groups including manual start/stop from the switch, or optionally programmed automatic-stop after a user-selectable duration between five minutes and 12 hours.

b. Color: [Ivory] [White] [Light Almond] [Stainless Steel].

E. Wired Networked Auxiliary Input / Output (I/O) Devices:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nIO series or comparable product by one of the following:
 - a. Cooper Lighting Solutions, LLC.
 - b. Leviton Manufacturing Co., Inc.
2. Plenum rated.
3. Mounting: extended chase nipple for mounting to a 1/2-inch (16 mm) knockout.
4. Communication and low-voltage power delivered to each device via standard low-voltage network cabling with RJ-45 connectors.
5. Auxiliary Input/Output Devices Options:
 - a. Contact closure or pull-high input.
 - 1) Input programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, activate lights at a preconfigured level, ramp light level up or down, or toggle lights on/off.
 - b. 0-10V analog input.
 - 1) Input supports zero to 10 V dimming output control from a dimmer switch.
 - 2) Input programmable to function as a daylight sensor.
 - c. RS-232/RS-485 digital input.
 - 1) Input supports activation of up to four local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
 - 2) Provides relay and dimming level status to external device (e.g. Touchscreen) when polled.
 - d. 0-10V dimming control output, capable of sinking up to 20mA.
 - 1) Output programmable to support all standard sequence of operations supported by system.
 - e. Digital control output via eidoLED LEDcode communication.
 - 1) Output programmable to support light intensity control, as well as optional correlated color temperature (CCT) control, of the connected luminaire.

F. Wired Networked Occupancy and Photosensors:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; [nCM] [nCMB] [nRM] [nWV] [nHW] or comparable product by one of the following:
 - a. Cooper Lighting Solutions, LLC.
 - b. Leviton Manufacturing Co., Inc.
2. Detect the presence of human activity within space and fully control the on/off function of lights.
3. Utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic and Microwave-based sensing technologies are unacceptable.
4. Dual technology sensors used in locations where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions).
5. Dual technology sensors must have one sensing technology not motion dependent to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT), which detects both occupant motion and sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) are unacceptable.
6. All sensing technologies are acoustically passive, meaning they do not transmit sound waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers and hearing devices). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonic technology. Ultrasonic and Microwave-based sensing technologies are unacceptable.
7. Ceiling, fixture, recessed, and corner mounted sensors available, with multiple lens options available customized for specific applications.
8. Communication and low-voltage power delivered to each device via standard low-voltage network cabling with RJ-45 connectors.
9. All sensors detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
10. Sensor programming parameter available and configurable remotely from the software and locally via the device push button.
11. Ceiling mount occupancy sensors include one integrated dry contact switching relay, capable of switching 1 A at 24 V, resistive only.
12. Sensors available with one or two occupancy "poles," each of which provides a programmable time delay.
13. Photosensor/daylight override, automatic dimming control, and low temperature/high humidity operation.
14. Photosensor provide one on/off set-point and include a dead band to prevent the artificial light from cycling. Delay incorporated into the photosensor to prevent rapid response to passing clouds.
15. Photosensor and dimming sensor's set-point and dead band automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-Point Programming" procedure. Min and max dim settings as well as set-point may be manually entered or modified.
16. Dead band setting verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
17. Dual zone option available for On/Off Photosensor, Automatic Dimming Control Photosensor, or Combination units. The secondary daylight zone capable of being controlled as an "offset" from the primary zone.

G. Wired Networked Wall Switch Sensors:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; [nWSX LV] [nWSXA LV] or comparable product by one of the following:
 - a. Cooper Lighting Solutions, LLC.
 - b. Leviton Manufacturing Co., Inc.
2. Mounting: Suitable for installation in single-gang switch box.
3. Communication and low-voltage power delivered via standard low-voltage network cabling with RJ-45 connectors.
4. All switches detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.

5. Devices with mechanical push buttons provide tactile and LED user feedback.
6. Wall Switch Sensor Options:
 - a. User Input Control Types: [On/Off] [On/Off/Dimming].
 - b. Occupancy Sensing Technology: [PIR only] [Dual technology acoustic].
 - c. Daylight Sensing Option: Inhibit Photosensor.
 - d. Color: [Ivory] [White] [Light Almond] [Gray] [Black] [Red].

H. Wired Networked Power Packs:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nPP16 series or comparable product by one of the following:
 - a. Cooper Lighting Solutions, LLC.
 - b. Leviton Manufacturing Co., Inc.
2. Plenum rated.
3. Communication will be delivered to each device via standard low-voltage network cabling with RJ-45 connectors.
4. Supply Voltage: [120 to 277] V(ac).
5. Relay Output: Class 1 relay rated for 16 A at [277] V(ac) and 1/2 HP at 120 V(ac).
6. Dimming Output: 0-10 VDC Dimming output.
7. Sink Current: 100 mA at 0-10 V(dc).
8. Mounting: Integral 1/2-inch (16-mm) chase nipple. Plastic clips into junction box are unacceptable.

I. Wired Networked Relay and Dimming Panel:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; ARP or comparable product by one of the following:
 - a. Cooper Lighting Solutions, LLC.
 - b. Leviton Manufacturing Co., Inc.
2. Outputs: 4 to 48 Individual relays per panel, with an equal number of individual 0-10 V(dc) dimming outputs.
3. Field Configurable Relays (FCR):
 - a. Field configurable to operate in single-, double-, or triple-pole relay groupings.
 - b. Field configurable to operate as normally closed or normally open.
 - c. Provides visual status of current state and manual override control of each relay.
 - d. Minimum Relay Contact Ratings:
 - 1) 40 A at 120-480 V(ac) Ballast.
 - 2) 16 A at 120-277 V(ac) Electronic.
 - 3) 20 A at 120-277 V(ac) Tungsten.
 - 4) 20 A at 48V (dc) Resistive.
 - 5) 2 HP at 120 V(ac).
 - 6) 3 HP at 240-277 V(ac).
 - 7) 65kA SCCR at 480 V(ac).
4. Dimming Output Rating: Minimum of 100 mA sink current per dimming output.
5. Relay and dimming outputs individually programmable.
6. Listing: UL 924 for control of emergency lighting circuits.
7. Power Supply: Integrated 120-277 V(ac) supply.
8. Low-Voltage Sensor Input:

- a. Configurable to support any of the following input types:
 - 1) Indoor Photosensor.
 - 2) Outdoor Photosensor.
 - 3) Occupancy Sensor.
 - 4) Contact Closure.
 - b. Low-voltage sensor input provides 24 V(dc) power for sensor so additional auxiliary power supplies are not required.
 - c. Sensor input supports all standard sequence of operations.
9. Integrated Digital Time Clock for local schedule control.
 10. Contact Closure Input: One for each group of eight output relays that acts as a panel override to activate the normally configured state of all associated relays (i.e., normally open or normally closed).
 11. Panel supplies current limited low-voltage power to other networked devices connected via low-voltage network cable.
 12. Enclosure:
 - a. Enclosure Rating: NEMA 1.
 - b. Mounting: Surface mounted.
 - c. Cover: Hinged cover with keyed lock or Screw-fastened and plenum rated.
- J. Wired Networked Bluetooth Low-Energy Programming Device:
1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nIO BT or comparable product by one of the following:
 - a. Cooper Lighting Solutions, LLC.
 - b. Leviton Manufacturing Co., Inc.
 2. Plenum rated, inline wired, and screw mountable.
 3. Communication and low-voltage power delivered to device via standard low-voltage network cabling with RJ-45 connectors.
 4. Bluetooth communication allows connection from smartphone application for programming device settings within the local daisy-chain zone.
 5. Device provides visual indication of remote Bluetooth connection via LED integrated into device enclosure such that it is visible from all angles while the zone is being programmed.
- K. Wired Networked Communication Bridge:
1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nBRG or comparable product by one of the following:
 - a. Cooper Lighting Solutions, LLC.
 - b. Leviton Manufacturing Co., Inc.
 2. Suitable for surface mount to a standard 4 by 4-inch square junction box.
 3. Communication Ports: Eight RJ-45 ports for connection to lighting control zones (up to 128 devices per port), additional network bridges, and System Controller.
 4. Capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to System Controller.
 5. Power Input: Class 2 low-voltage supplied locally via a directly wired power supply.
 6. Wired Bridge capable of redistributing power from its local supply and connected lighting control zones with excess power to lighting control zones with insufficient local power. Architecture enables loss of power to a particular area to be less impactful on network lighting control system.

2.6 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors. Minimum conduit size is 3/4 inch.
 - 1. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
 - 2. Comply with requirements for raceways and boxes specified in Section 260533.13 "Conduits for Electrical Systems," and Section 260533.16 "Boxes and Covers for Electrical Systems,"
- B. 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.

2.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, boxes, cabinets, and terminals. Comply with identification requirements specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with Section 260553 "Identification for Electrical Systems."
- C. Identify all controls with device address.
- D. Label each device cable within 6 inch of connection to bus power supply or termination block.

2.8 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test continuity of each circuit.
- B. Field tests and inspections must be witnessed by authorities having jurisdiction.
- C. Tests and Inspections: Engage a factory-authorized service representative to perform test inspections.
 - 1. Test each zone using local and remote control hardware.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
- D. Nonconforming Work:
 - 1. Lighting controls will be considered defective if they do not pass tests and inspections.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- E. Field Test Reports: Engage a factory-authorized service representative to field test reports.
 - 1. Prepare functionality and inspection reports, including a certified report that identifies controls included and describes test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.
 - 2. Include list of all points created from actual tests of all addressed control points for lamps, ballasts, manual controls, and sensors.

2.9 REMOTE ACCESS

- A. Digital network lighting control system capable of remote access by manufacturer with the following features:
 - 1. System diagnostics including detection of fault condition in hardware or connected devices.
 - 2. Access to all connected devices for complete programming including scheduling of time-of-day events and device parameters necessary to meet required sequence of operations.
 - 3. Browser-based interface to verify system functionality.
 - 4. On-demand access to manufacturer technical support for remote troubleshooting, diagnostics, configuration, and programming.
 - 5. Owner training on the digital network lighting control system available remotely.
- B. Remote access system fully functional over commercial cellular connection or Internet-connected ethernet network.
- C. All hardware associated with remote access including cellular modem and cellular antenna are to remain on-site regardless of warranty or cellular contract status.

2.10 SYSTEM STARTUP

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's published instructions.
 - 2. Activate luminaires and verify that all maximum output levels match output levels detailed in an Owner-approved sequence of operations.
 - 3. Confirm correct communications wiring, initiate communications between control devices and controller/gateways, and program the lighting control system in accordance with approved configuration schedules, time-of-day schedules, and input override assignments.
 - 4. Program network devices to meet required sequence of operations.
 - 5. Program and verify all sequence of operations.
 - 6. Create backup of system programming.
 - 7. Assist in installation of system software on customer-provided workstation or server.
 - 8. Verify bidirectional communication of manufacturer-provided cellular router with manufacturer-managed remote access portal.
- B. Commissioning Walkthrough: Engage factory-authorized service representative to collaborate with third-party commissioning agent to demonstrate lighting control system functionality and verify the system meets the specified Project requirements.

2.11 CLOSEOUT ACTIVITIES

- A. Enhanced Documentation: Engage lighting system manufacturer to provide comprehensive system documentation including detailed programming, sequence of operation data per Project specifications, and related code requirements.
- B. Training: Engage lighting system manufacturer to provide comprehensive system overview, software overview, and documentation relating to system operation and maintenance.

2.12 PROTECTION

- A. After installation, protect digital network lighting controls from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

2.13 MAINTENANCE

- A. Engage a factory-authorized service representative to perform on-site system adjustments.
 - 1. On-Site Occupancy Adjustments: When requested within six months from date of Substantial Completion, provide on-site settings adjustments to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 2. Prepare and submit report after each visit that details activities performed.

- B. Engage a factory-authorized service representative to perform remote system adjustments.
 - 1. Remote Occupancy Adjustments: When requested within six months from date of Substantial Completion and project registration with lighting control system manufacturer, provide remote settings adjustments to suit actual occupied conditions. Provide up to two sessions to Project during other-than-normal occupancy hours for this purpose.
 - a. System to include manufacturer-provided cellular communication hardware and connection to the system for a minimum of 12 months after substantial completion to allow for factory representative assistance with settings adjustments and system sustainment.
 - b. For the remaining duration of the maintenance term, or in the event cellular connectivity is not available, manufacturer assistance must be available through an Owner-provided, Internet-connected network.
 - 2. Prepare and submit report after each session that details activities performed.

- C. Maintenance Service Agreement:
 - 1. Preventative maintenance to include:
 - a. System diagnostic reports.
 - b. System performance checks.
 - c. Device firmware updates.
 - d. Programming adjustment as required for proper lighting system operation.
 - e. Expedited factory direct warranty processing, replacement, and programming of defective components.
 - 2. Verify that parts and supplies are manufacturer's authorized replacement parts and supplies.

END OF SECTION 26 09 43

SECTION 26 21 00 - LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 31 23 16 - Excavation.
- E. Section 31 23 23 - Fill: Bedding and backfilling.

1.2 DEFINITIONS

- A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.3 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. IEEE C2 (National Electrical Safety Code).
 - 2. NFPA 70 (National Electrical Code).
 - 3. The requirements of the Utility Company.

PART 2 PRODUCTS

2.1 ELECTRICAL SERVICE REQUIREMENTS

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics:
 - 1. Service Type: Underground.
 - 2. Service Voltage: 480Y/277 V, 3 phase, 60 Hz.
- C. Utility Company: Entergy.
- D. Division of Responsibility:
 - 1. Pad Mounted Utility Transformers:
 - a. Transformers: Furnished and installed by Utility Company.
 - b. Transformer Grounding Provisions: Furnished and installed by Utility Company.
 - c. Primary: Primary Conduits Furnished and installed by Electrical Contractor. Primary Conductors Furnished and installed by Utility Company.
 - d. Secondary - Underground Service:
 - 1) Conduits: Furnished and installed by Contractor.
 - 2) Conductors: Furnished and installed by the Contractor.
 - 2. Terminations at Service Point: Provided by the Contractor.
 - 3. Metering Provisions:
 - a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.
 - b. Metering Transformer Cabinets: Furnished and installed by Contractor per Utility Company requirements.
 - c. Metering Transformers: Furnished and installed by Utility Company.

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- d. Conduits Between Metering Transformers and Meters: Furnished and installed by Contractor per Utility Company requirements.
 - e. Wiring Between Metering Transformers and Meters: Furnished and installed by Utility Company.
- E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1.
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required trenching and backfilling in accordance with Section 31 2316 and Section 31 2323.
- E. Provide required support and attachment components in accordance with Section 26 0529.
- F. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.
- G. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

END OF SECTION 26 21 00

SECTION 26 22 00 – LOW VOLTAGE TRANSFORMERS

PART 1 – GENERAL

1.1 SUMMARY:

- A. This section covers dry type transformers 600V and below.
- B. Refer to the following sections for work specified elsewhere:
 - 1. 26 05 00 “Common Work Results for Electrical”

1.2 SUBMITTALS:

- A. Manufacturer’s Data: Submit copies of manufacturer’s specifications and product data for products to be used.

1.3 QUALITY ASSURANCE:

- A. Furnish standard products and manufacturers regularly engaged in production of such equipment.
- B. All materials shall be fully warranted.
- C. All equipment shall conform to applicable IEEE, UL, ANSI and/or NEMA Standards.

PART 2 - PRODUCTS

2.1 CONSTRUCTION:

A. GENERAL:

- 1. Transformers will be of the indoor ventilated type or totally enclosed encapsulated type for sizes less than 15 KVA.
- 2. Transformers shall be two windings type, delta configured primary and wye configured secondary for 60-hertz operation.
- 3. Transformer voltage, capacity and phase configuration shall be as indicated on the contract drawings.
- 4. Transformers shall have external ground lugs internally connected by the factory to the transformer neutral.
- 5. Transformers shall have completely isolated core and coil unit from the enclosure by vibration absorbing mounts.

6. WINDING TAPS:

- a. Transformers less than 15 KVA: Two (2) 5% below rated voltage, full capacity taps on primary winding.
- b. Transformers 15 KVA and Larger: Six (6) 2 ½% [four (4) below, two (2) above] rated voltage, full capacity taps on primary winding.

- 7. Transformers shall not exceed the following sound level values.

| | | | |
|---------------|-------|----------------|-------|
| 0 to 9 KVA | 40 dB | 151 to 300 KVA | 55 dB |
| 10 to 50 KVA | 45 dB | 500 KVA | 60 dB |
| 51 to 150 KVA | 50 dB | | |

- 8. Transformers shall not exceed 5.75% average impedance.

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9. Transformers may be provided as part of the unitized gear package.

B. INSULATION:

1. Insulation systems:
 - a. 01 through 09 KVA: Class F insulation for 185°C total temperature.
 - b. 10 KVA and above: Class H insulation for 220°C total temperature.
2. They shall carry the design load without exceeding a 115°C rise above 40°C ambient. The design load equals the calculated demand load and spare circuit capacity.

C. APPROVED MANUFACTURERS:

1. Schneider Electric/Square D
2. Siemens
3. General Electric
4. Eaton/Cutler Hammer

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Ground each transformer to building's system ground.
- B. All connections to transformers shall be made with flexible metallic conduit.
- C. Clear space between walls and ventilated sides of transformer shall be not less than 6" or the manufacturer's placement requirements, whichever is greater.
- D. Furnish and install vibration isolation pads under transformer bases in contact with floor or suspension support members. Type WP sandwich pads as manufactured by California Dynamics Corp., Los Angeles CA., or equal.

END OF SECTION 26 22 00

SECTION 26 24 13 – SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY:

A. This section covers:

1. Front and Side Accessible switchboard for the Main Switchboard (service entrance). Main Switchboard shall have individually mounted main device service entrance section and integral distribution. Main switchboard shall be front and rear aligned.
2. Front-Accessible switchboards for application as Store Main Distribution and HVAC Distribution Switchboard. All sections in one lineup, except remote HVAC, where applicable. Group mounted molded case circuit breakers for feeders.

B. Switchboards may be part of Owner-furnished switchgear package. Refer to contract drawings.

C. Refer to the following sections for work specified elsewhere:

1. 26 05 00 "Common Work Results for Electrical"
2. 26 05 34 "Conduits"
3. 26 05 19 "Low Voltage Electrical Power Conductors and Cables"
4. 26 21 00 "Low Voltage Electrical Service Entrance"

1.2 SUBMITTALS: Manufacturer shall provide copies of following documents to owner for review and evaluation in accordance with general requirements of Division 1 and electrical-related divisions:

- A. Product Data on specified product; submit all components of switchboard including meter, main, and CT's.
- B. Shop Drawings on specified product
- C. Trip curves for each specified product for record in O&M manual
- D. Copies of installation, operation and maintenance procedures to owner in accordance with general requirements of Division 1 and electrical-related divisions.

1.3 QUALITY ASSURANCE:

- A. Manufacturer shall have specialized in the manufacture and assembly of low voltage switchboards for at least twenty-five (25) years.
- B. The low voltage switchboards and protection devices in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):
 1. ANSI C39.1 - 1981 (R1992), Electrical Analog Indicating Instruments, Requirements for
 2. ANSI/IEEE C57.13 - 1978 (R1987), Instrument Transformers, Requirements for
 3. ANSI/NEMA PB 2 - 1989, Dead-front Distribution Switchboards
 4. ANSI/NFPA 70 - 1993, National Electrical Code

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5. Federal Specification W-C-375, Rev. B, Amend. 1, Circuit Breakers, Molded Case; Branch Circuit and Service
6. NEMA AB 1 - 1993, Molded Case Circuit Breakers and Molded Case Switches
7. NEMA PB 2.1 - 1991, General Instructions for Proper Handling, Installation, Operation and Maintenance of Dead-front Distribution Switchboards Rated 600 Volts or Less
8. UL 489 - 1991, Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
9. UL 891 -1994, Dead-Front Switchboards
10. UL 98 - 1994, Enclosed and Dead-front Switches

1.4 DELIVERY, STORAGE, AND HANDLING:

- A. Contractor shall store, protect, and handle products in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals.
- B. Ship each switchboard section in individual shipping splits for ease of handling. Each section shall be mounted on shipping skids and wrapped for protection.
- C. Contractor shall inspect and report concealed damage to carrier within 48 hours.
- D. Contractor shall store in a clean, dry space. Maintain factory protection or cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. (Heat enclosures to prevent condensation.)
- E. Contractor shall handle in accordance with manufacturer's written instructions to avoid damaging equipment, installed devices, and finish. Lift only by installed lifting eyes.

1.5 WARRANTY: Manufacturer shall warrant equipment to be free from defects in materials and workmanship for 1 year from date of installation or 18 months from date of purchase, whichever occurs first.

1.6 FIELD MEASUREMENTS: Contractor shall make all necessary field measurements to verify that equipment shall fit in allocated space in full compliance with minimum required clearances specified in National Electrical Code.

PART 2 - PRODUCTS:

2.1 EQUIPMENT:

- A. Acceptable manufacturers are Schneider Electric/Square D, Siemens, GE and Eaton/Cutler Hammer.
- B. Furnish Switchboards as indicated in the drawings and specifications, and following the table:

| | Schneider Electric/Square D | SIEMENS |
|---|------------------------------------|-----------------|
| SWITCHBOARD STYLE | QED-2 | Siemens Sentron |
| MAIN (Insul. Case stored energy fixed brkr) | Masterpact NW w/Micrologic | SB |
| ELECTRONIC METER PACKAGE | PM820 | 4720 |
| DISTRIBUTION BREAKERS | Molded Case | Molded Case |

2.3 COMPONENTS: Refer to Drawings for: actual layout and location of equipment and components; current ratings of devices, bus bars, and components; voltage ratings of devices, components and assemblies; and other required details.

A. Standard Features

1. Switchboards shall be fully self-supporting structures with 91.5 inch tall vertical sections (excluding lifting eyes and pull boxes) bolted together to form required arrangement.
2. Switchboard(s) shall be NEMA 1 deadfront construction.

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3. Switchboard frame shall be die formed steel with reinforced corner gussets. Frame shall be rigidly bolted to support cover plates, bus bars and installed devices during shipment and installation.
4. All sections may be rolled, moved or lifted into position and shall be rear aligned.
5. All switchboard sections shall have open bottoms and removable top plate(s) to install conduit.
6. Switchboard shall be UL listed to accept circuit breakers or fusible switches, factory or field installed. Preference is circuit breakers.
7. Switchboards that are series rated to short circuit requirements shall be appropriately labeled. Tested UL listed combination ratings shall be included in UL recognized Component Directory (DKSY2).
8. All covers and doors shall be fastened by hex head bolts.
9. All doors shall have concealed hinges.
10. Show all top and bottom conduit areas on shop drawings.
11. Switchboard protective devices shall be furnished as listed on drawings and specified in these specifications, including interconnections, instrumentation and control wiring.
12. Maximum main device rating shall be 600 VAC, 4000 amperes. Maximum feeder device rating shall be 600 VAC, 1200 amperes.
13. Switchboard current ratings, including all devices, shall be based on 25 degree C ambient temperature, and UL 891.
14. Provide mimic bus power flow nameplate on face of switchboard.

B. Bus Bars

1. Bus bars shall be silver plated copper. Bus bars shall be rated for current density of 750 amperes per square inch aluminum or 1000 amperes per square inch copper. Phase and neutral bus ampacity shall be as shown on the drawings. For 4-wire systems, neutral shall have same ampacity as phase bus bar. Tapered cross-bus shall not be acceptable. Full provisions for the addition of future sections shall be provided.
2. Bus bars shall be mounted on high-impact, non-tracking insulated supports.
3. Bus bars shall be braced to withstand mechanical forces exerted during short circuit conditions as indicated in drawings.
4. Bus joints shall be bolted with high tensile steel Grade 5 bolts. Belleville type washers shall be provided. All bus bar connections shall be made using the Belleville washers. Welded connections are unacceptable.
5. Ground Bus shall be sized to meet UL 891. Ground bus shall extend full length of switchboard.
6. A-B-C bus arrangement (left-to-right, top-to-bottom, front-to-rear) shall be used throughout to assure convenient and safe testing and maintenance. Where special circuitry precludes this arrangement, bus bars shall be labeled.
7. All feeder device line and load connections shall be rated to carry current rating of device frame (not trip rating).
8. The main incoming bus bars shall be rated for the main protection device or main incoming conductors.

C. Main Lugs

1. All lugs shall be tin-plated copper and UL listed for use with stranded copper cable. Ampacity shall be based on 75 degree C conductor temperature ratings.

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2. Provide compression type lugs to accommodate conductors. Use Belleville washers for all bolted connections.

D. Individually Mounted Main Devices (Main Switchboard)

1. Individually mounted main breakers shall be insulated case stored energy circuit breakers as shown on the drawings. All switchboard devices will be padlockable in the "off" position.
2. Main protective devices shall be fixed, individually mounted with incoming line terminals to accommodate either cable or bolted bus connections.
3. Circuit breakers shall be 100 percent rated to current ratings indicated in drawings.
 - a. Where possible, sensors shall be same size as breaker frame.
 - b. Breakers shall be manually operated.
 - c. Breakers shall be stationary mounted.
 - d. Breakers with the same frame sizes and same short circuit rating shall be interchangeable.
 - e. Breakers shall be suitable for reverse feeding.
 - f. Breaker shall have easy to operate, rotary, handle-operated, true two-step stored energy mechanism with a five cycle maximum closing time.
 - g. Separate indicators shall be provided to show charged/discharged status of the mechanism and open/closed status of the main contacts.
 - h. Breaker closing function shall be local closing button on breaker face and shall be able to have all 3 primary breaker contacts padlocked in OFF position to prevent unauthorized breaker closing.
 - i. Local closing function shall be a "hidden" ON button to prevent unintentional closing of charged breaker.
 - j. Breaker to include microprocessor-based trip units designed for true RMS sensing with sensing accuracy through the 13th harmonic and fully adjustable characteristics necessary for a selective coordinated system.
 - k. Microprocessor trip unit shall be plug-in for interchangeability in the field.
 - l. The adjustable ground fault pickup and delay shall have a maximum setting of 1200 amperes to meet the requirements of the NEC.
 - m. Fault indicators shall be provided on the trip unit for overload, short time, short circuit and ground fault and should be self-powered.

E. Group-Mounted Devices (distribution)

1. Circuit breaker(s) shall be group-mounted on common rail assembly.
2. Group-mounted feeder devices shall be bolted to the mounting pan and connected to the section vertical bus by insulated bus bars. The bus bars shall be attached to the feeder device by rack-on jaw connections.
3. Group-mounted breakers shall be interchangeable trip high interrupting. Main device shall have integral ground fault and shunt trip.
4. Distribution section shall have three flat, stacked, vertically aligned bus bars arranged to accept the insulated bus bars from the feeder devices.

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5. The interior of each distribution section shall have a full height vertical bus bar. The vertical bus shall have a single bar. Joints in the vertical bus are not permitted.

F. GROUND FAULT PROTECTION: The ground fault sensing protection system shall be of the zero sequence type. The zero sequence ground fault protection system shall include the following (should be integral with the main breaker):

1. The system shall have coordinated ground sensor CT's and solid state relays to operate the shunt trip of the main interrupter.

2. The system shall have an adjustable setting range including a 400 AMP pick-up setting to permit a maximum of 15,000 KW-cycle into the arcing ground.

G. TRANSIENT VOLTAGE SURGE SUPPRESSOR (TVSS): This is a requirement. Device(s) shall be located within the switchboard cabinet at a position to allow a very short distance for the connecting conductors. Provide remote indicator light panel in the switchboard front. Labeling of the remote indicating lights shall be same as the labeling on the surge arrester unit and shall include a surge counter. Unit must be on a load breaker downstream of the store main. Schneider Electric/Square D type EMA, rated 240kA per phase.

2.4 METERING:

A. Furnish electronic meter package per 2.02, as required by drawings.

B. All instrument transformers shall be UL listed and classified as indicated in drawings.

C. Current Transformers shall be as shown on drawings with burden and accuracy to support connected meters and relays as required by [ANSI/IEEE C57.13].

D. Potential transformers shall be as shown on drawings with burden and accuracy to support connected meters and shall be integral to the meter.

E. The ELECTRONIC meter shall be a full-function, electronic meter. The solid-state device shall have a front panel display and control buttons and shall contain a ready-to-use communication network port for access by remote computer.

1. The ELECTRONIC meter shall include:

a. Front panel: 20 character vacuum fluorescent display to show four fields (4 digits - volts; 1 digit - phase; 4 digits - amps; 5 digits/8 characters - power functions.)

b. Back Panel: 3 utility approved terminal strips and grounding terminal for all external connections.

c. Internal: The unit is based on a 12 MHz, 16 bit microprocessor.

2. The ELECTRONIC meter shall have three Form C (one closed and one open contact) control relays to operate external components.

a. Relays shall be able to operate in a latched mode (steady state operated or released) or a pulsed output mode.

b. Relay time responses are at least one to two seconds (up to five seconds following initial meter power up).

F. Communications

1. The ELECTRONIC meter shall communicate with remote host computer, IBM PC/XT or PC/AT (or compatible). Host access to meter information shall be provided by PowerLogic SMS software.

2. The meter shall have a field installable communications card for use via RS-485 communications standards. The card shall be optically coupled to isolate communication lines from metering equipment.

G. Software capabilities

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1. The ELECTRONIC meter shall have the following on-board data logging capabilities:
 - a. Event log to record events such as power up, parameter changes, alarm conditions, relay and status input changes. Users shall be able to retrieve the 50 most recent events;
 - b. Snapshot log to provide historical record of voltage, current and all power values (twelve total parameters, 1200 record capacity) recorded at user-defined intervals. Users shall be able to retrieve the 100 most recent snapshots.
 - c. MIN/MAX log to record the extreme values for volts, current, power and other measured values (17 total parameters in one preset log). Users shall be able to read these values on the meter front panel or at the host computer.
2. The ELECTRONIC meter uses a sliding window demand measurement method. The user can program the demand period and demand interval.
3. User-programmable setpoints to control the on-board relays and trigger the event log.

H. Standard metering functions shall include:

1. Volts (I-I and I-n), three phases
2. Amps, three phases
3. Neutral current
4. KW
5. KVAR
6. KVA
7. Power Factor
8. Frequency
9. KW Demand
10. Amps Demand
11. KWH (Forward /imported, Reverse/exported)
12. KVARH (Forward, Reverse)

2.5 FINISH:

- A. All steel surfaces shall be chemically cleaned prior to painting.
- B. Exterior paint color shall be ANSI 49 Medium-Light Grey over phosphate-type rust inhibitor.

2.6 ACCESSORIES:

- A. Software program for PC.
- B. Accessories to support metering devices including RS-485 communication port.
- C. Furnish nameplates for each device as indicated in drawings. Color schemes shall be as indicated on drawings.

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PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Building ground connections shall be made on the line side of the ground link section.
- B. All service connection extensions shall follow the local utility company requirements.
- C. Provide and install all appurtenances necessary for tying into the service connection points.
- D. Provide and install all conduits, backboards and support for utility company metering equipment.
- E. Install all grounding as required. Refer to Section 26 05 26 and details.
- F. Install main switchboard on a 4" house keeping concrete pad.
- G. Coordinate all locations, size and necessary opening details with anticipated building construction.
- H. Provide mounted one-line riser diagram and permanently affix to main switchboard room wall in front of switchboard or as an engraved plastic plate mounted on the switchboard.

END OF SECTION 26 24 13

SECTION 26 24 16 - PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 28 13 - Fuses: Fuses for fusible switches and spare fuse cabinets.
- E. Section 26 43 00 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2009.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- N. UL 943 - Ground-Fault Circuit-Interruption; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

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5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.
- E. Field Quality Control Test Reports.
- F. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Electrical System:
 1. Utility Company: Mississippi Power Company
 2. Service Voltage; 208Y/120 Volts, 3 phase, 4 wire, 60 Hz.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation
- B. General Electric Company
- C. Schneider Electric; Square D Products
- D. Siemens Industry, Inc.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 1. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:
 1. Provide panelboards with listed short circuit current rating as indicated on the drawings.

2. Listed series ratings are not acceptable.
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 2. Provide 200 percent rated neutral bus and lugs where indicated, where oversized neutral conductors are provided, or where panelboards are fed from K-rated transformers.
 3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 4. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
 - c. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
 3. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- J. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list and label panelboards as a complete assembly including surge protective device.

2.3 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Products:
 1. Eaton Corporation
 2. General Electric Company
 3. Schneider Electric; Square D Products
 4. Siemens Industry, Inc.
- C. Conductor Terminations:
 1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
 2. Main and Neutral Lug Type: Mechanical.
- D. Bussing:
 1. Phase and Neutral Bus Material: Copper.
 2. Ground Bus Material: Copper.
- E. Circuit Breakers:
 1. Provide bolt-on type.
 2. Provide thermal magnetic circuit breakers unless otherwise indicated.
- F. Enclosures:

1. Provide surface-mounted enclosures unless otherwise indicated.
2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

2.4 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Products:
 1. Eaton Corporation
 2. General Electric Company
 3. Schneider Electric; Square D Products
 4. Siemens Industry, Inc.
- C. Conductor Terminations:
 1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
 2. Main and Neutral Lug Type: Mechanical.
- D. Bussing:
 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 2. Phase and Neutral Bus Material: Copper.
 3. Ground Bus Material: Copper.
- E. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- F. Enclosures:
 1. Provide surface-mounted or flush-mounted enclosures as indicated.
 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Provide compression lugs where indicated.
 - c. Lug Material: Copper, suitable for terminating copper conductors only.
 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
 6. Do not use tandem circuit breakers.
 7. Do not use handle ties in lieu of multi-pole circuit breakers.
 8. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 0529.
- E. Install panelboards plumb.
- F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- G. Mount panelboards such that the highest positions of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- H. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- I. Provide grounding and bonding in accordance with Section 26 0526.
 - 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
 - 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- J. Install all field-installed branch devices, components, and accessories.
- K. Provide fuses complying with Section 26 2813 for fusible switches as indicated.
- L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- M. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- N. Set field-adjustable circuit breaker tripping function settings. Obtain circuit breaker manufacturer's services to perform a short circuit and coordination study to obtain trip settings of all breaker functions. The Contractor shall obtain the utility padmount transformer characteristics from the Utility and also provide all feeder conductor lengths, motor ratings etc. and provide to the manufacturer for an engineered coordination study. Study shall be sealed by an Engineer registered in the State of Mississippi.
- P. Provide filler plates to cover unused spaces in panelboards.
- Q. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
 - 1. Emergency and night lighting circuits.
 - 2. Communications equipment circuits.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.

- C. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 24 16

SECTION 26 27 17 - EQUIPMENT WIRING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 34 - Conduit.
- C. Section 26 05 37 - Boxes.
- D. Section 26 27 26 - Wiring Devices.
- E. Section 26 28 18 - Enclosed Switches.
- F. Section 26 29 13 - Enclosed Controllers.

1.3 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Conform to NEMA WD 1.
 - 2. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 26 28 18 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 34.
- E. Wire and Cable: As specified in Section 26 05 19.
- F. Boxes: As specified in Section 26 05 37.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 26 27 17

SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 37 - Boxes.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 09 23 - Lighting Control Devices: Devices for automatic control of lighting, including in-wall time switches.
- E. Section 26 27 17 - Equipment Wiring: Cords and plugs for equipment.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- L. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
 - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
 - 6. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
 - 1. Wall Dimmers: Include derating information for ganged multiple devices.
- C. Field Quality Control Test Reports.
- D. Operation and Maintenance Data:
 - 1. Wall Dimmers: Include information on operation and setting of presets.
 - 2. GFCI Receptacles: Include information on status indicators.
- E. Project Record Documents: Record actual installed locations of wiring devices.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Hubbell Incorporated
- B. Leviton Manufacturing Company, Inc.
- C. Lutron Electronics Company, Inc.
- D. Pass & Seymour
- E. Source Limitations: Where possible, provide products for each type of wiring device produced by a single manufacturer and obtained from a single supplier.
- F. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

2.2 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide GFCI protection for receptacles installed within 6 feet of sinks.
- E. Provide GFCI protection for receptacles serving electric drinking fountains.
- F. For flush floor service fittings, use tile rings for installations in tile floors.
- G. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.3 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: As selected by the Architect with brushed, stainless steel wall plate.
- C. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- D. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover. IP 66 rating for all outdoor devices.

2.4 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated
 - 2. Leviton Manufacturing Company, Inc.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc.

- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Commercial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- D. Pilot Light Wall Switches: Commercial specification grade, 20 A, 120/277 V with red illuminated standard toggle type switch actuator and maintained contacts; illuminated with load on; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- E. Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with toggle type three position switch actuator and momentary contacts; single pole double throw, off with switch actuator in center position.

2.5 WALL DIMMERS

- A. Manufacturers:
 - 1. Leviton Manufacturing Company, Inc.
 - 2. Lutron Electronics Company, Inc.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc.
- B. Wall Dimmers - General Requirements: 0-10V control or solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings. Coordinate exact type with Luminaire controlled.
- C. Control: Slide control type with separate on/off switch.
- D. Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:
- E. Provide accessory wall switches to match dimmer appearance when installed adjacent to each other.

2.6 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated
 - 2. Leviton Manufacturing Company, Inc.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc
 - 4. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
 - 1. Standard Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 - 2. Isolated Ground Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; isolated ground triangle mark on device face; single or duplex as indicated on the drawings.
 - 3. Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
 - 4. Split Controlled Receptacles: Commercial Specification Grade, Tamper Proof Equal to Leviton TBR20-S1.
- D. GFCI Receptacles:

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1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 2. Standard GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 3. Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R , rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
- E. Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.

2.7 WALL PLATES

- A. Manufacturers:
1. Hubbell Incorporated
 2. Leviton Manufacturing Company, Inc.
 3. Lutron Electronics Company, Inc.
 4. Pass & Seymour
 5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard
 3. Screws: Metal with slotted heads finished to match wall plate finish.
- C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- D. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
- E. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.
- F. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type. Use IP 66 covers for devices located below the Base Flood Elevation.

2.8 FLOOR BOX SERVICE FITTINGS

- A. Manufacturers:
1. Hubbell Incorporated
 2. Thomas & Betts Corporation
 3. Wiremol
- B. Description: Service fittings compatible with floor boxes provided under Section 26 0537 with components, adapters, and trims required for complete installation.
- C. Above-Floor Service Fittings:
1. Single Service Pedestal Convenience Receptacles:
 - a. Configuration: One standard convenience duplex receptacle.
 2. Single Service Pedestal Communications Outlets:
 - a. Configuration: One 1 inch bushed opening.
 - b. Voice and Data Jacks: Provided by others.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings. Coordinate with other trades and vertically and horizontally align all devices including thermostats, fire alarm appliances, etc. Coordinate installation of boxes with millwork.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

- D. Verify that final surface finishes are complete, including painting.
- E. Verify that floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130 , including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switches: 48 inches above finished floor.
 - b. Wall Dimmers: 48 inches above finished floor.
 - c. Receptacles: 18 inches above finished floor or 6 inches above counter or as noted on the Drawings.
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
 - 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, does not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- L. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch and wall dimmer with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

A. Locations of devices shall be relocated prior to installation up to 10 feet without additional cost to the Owner. Note: The Contractor shall comply with the documents for symmetrical alignment of devices with architectural features and devices specified under other Divisions. Refer to Drawing Notes.

1. The Contractor shall arrange and perform a pre-installation planning meeting with the Architect and Engineer to specifically locate devices and associated raceway on exposed beams and columns.

- B. Adjust devices and wall plates to be flush and level.
- C. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.
- D. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.
- E. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses; Current Edition, Including All Revisions.

1.2 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.3 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.1 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.
- H. Class T Fuses: Comply with UL 248-15.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION 26 28 13

SECTION 26 28 17 - ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.2 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1.4 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.1 ENCLOSED CIRCUIT BREAKERS

- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between 23 degrees F and 104 degrees F.
- D. Short Circuit Current Rating:
 - 1. Provide enclosed circuit breakers with listed short circuit current rating as indicated on the drawings.
- E. Conductor Terminations: Suitable for use with the conductors to be installed.
- F. Provide thermal magnetic circuit breakers unless otherwise indicated.
- G. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- H. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

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1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 2. Provide surface-mounted enclosures unless otherwise indicated.
- J. Provide externally operable handle with means for locking in the OFF position.
- 2.2 MOLDED CASE CIRCUIT BREAKERS
- A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489 , and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
- B. Interrupting Capacity:
1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - a. 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
- C. Conductor Terminations:
1. Provide mechanical lugs unless otherwise indicated.
 2. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- D. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
- E. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install enclosed circuit breakers where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed circuit breakers securely, in a neat and workmanlike manner in accordance with NECA 1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 0529.
- E. Install enclosed circuit breakers plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 0526.

END OF SECTION 26 28 17

SECTION 26 28 18 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 28 13 - Fuses.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation
- B. General Electric Company
- C. Schneider Electric; Square D Products
- D. Siemens Industry, Inc.

2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Provide with switch blade contact position that is visible when the cover is open.
- G. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: As indicated on the drawings. or NEMA 4X Stainless Steel in outdoor locations.
- K. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- L. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install enclosed switches in accordance with manufacturer's instructions.
- B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 0529.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

- A. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

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3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 28 18

SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enclosed NEMA motor controllers for low-voltage (600 V and less) applications:
 - 1. Magnetic motor starters.
 - 2. Manual motor starters.
 - 3. Motor-starting switches without overload protection.
- B. Overcurrent protective devices for motor controllers, including overload relays.
- C. Motor control accessories:
 - 1. Auxiliary contacts.
 - 2. Control and timing relays.
 - 3. Control power transformers.
 - 4. Control terminal blocks.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 2923 - Variable-Frequency Motor Controllers.

1.3 REFERENCE STANDARDS

- A. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; Institute of Electrical and Electronic Engineers; 2008.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2014.
- D. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; National Electrical Manufacturers Association ; 2000 (R2005), with errata, 2008.
- E. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; National Electrical Manufacturers Association; 2000 (R2010).
- F. NEMA ICS 6 - Industrial Control and Systems: Enclosures; National Electrical Manufacturers Association; 1993 (R2011).
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).
- H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- J. UL 60947-1 - Low-Voltage Switchgear and Control gear - Part 1: General Rules; Current Edition, Including All Revisions.
- K. UL 60947-4-1 - Low-Voltage Switchgear and Control gear - Part 4-1: Contactors and Motor-Starters - Electromechanical Contactors and Motor-Starters; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.

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2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.
3. Coordinate the work to provide motor controllers and associated wiring suitable for interface with control devices to be installed.
4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
6. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Project Record Documents: Record actual installed locations of motor controllers and final equipment settings.
- D. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- 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. Electronic Trip Circuit Breakers: Provide one portable test set.
 3. Indicating Lights: Two of each different type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation
- B. General Electric Company
- C. Schneider Electric; Square D Products
- D. Siemens Industry, Inc.

2.2 ENCLOSED MOTOR CONTROLLERS

- A. Provide enclosed motor controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Enclosed motor controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.
- D. Service Conditions:
 1. Provide motor controllers and associated components suitable for operation under the following service conditions without derating:
 - a. Ambient Temperature: Between 32 degrees F and 104 degrees F.
 2. Provide motor controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- E. Short Circuit Current Rating:
 1. Provide motor controllers with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- F. Conductor Terminations: Suitable for use with the conductors to be installed.
- G. Enclosures:
 1. Comply with NEMA ICS 6.
 2. Environment Type per NEMA 250: NEMA 1 for indoor dry locations..
 3. Finish: Manufacturer's standard unless otherwise indicated.
- H. Instrument Transformers:
 1. Comply with IEEE C57.13.

ENCLOSED CONTROLLERS

2. Select suitable ratio, burden, and accuracy as required for connected devices.
 3. Current Transformers: Connect secondaries to shorting terminal blocks.
 4. Potential Transformers: Include primary and secondary fuses with disconnecting means.
- I. Magnetic Motor Starters: Combination type unless otherwise indicated.
1. Combination Magnetic Motor Starters: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
 2. Configuration: Full-voltage non-reversing unless otherwise indicated.
 3. Disconnects: Circuit breaker type.
 - a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.
 - b. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect switch in the ON position with capability of overriding interlock for testing purposes.
 - c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
 4. Overload Relays: Bimetallic thermal type unless otherwise indicated.
 5. Pilot Devices Required:
 - a. Furnish local pilot devices for each unit as specified below unless otherwise indicated on drawings.
 - b. Single-Speed, Non-Reversing Starters :
 - 1) Selector Switches: HAND/OFF/AUTO.
 - 2) Indicating Lights: Red ON, Green OFF.
- J. Manual Motor Starters:
1. Description: NEMA ICS 2, Class A manually-operated motor controllers with overload relay(s).
 2. Configuration: Non-reversing unless otherwise indicated.
 3. Fractional-Horsepower Manual Motor Starters:
 - a. Furnish with toggle operator.
 - b. Overload Relays: Bimetallic or melting alloy thermal type.
 4. Integral-Horsepower Manual Motor Starters:
 - a. Furnish with toggle or pushbutton operator.
 - b. Overload Relays: Bimetallic or melting alloy thermal type.
- K. Motor-Starting Switches: Horsepower-rated switches without overload protection; toggle operator.
- 2.3 OVERCURRENT PROTECTIVE DEVICES
- A. Overload Relays:
1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
 2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
 3. Trip-free operation.
 4. Visible trip indication.
 5. Resettable.
 - a. Employ manual reset unless otherwise indicated.
 - b. Do not employ automatic reset with two-wire control.
 6. Solid-State Overload Relays:
 - a. Adjustable full load current.
 - b. Phase loss protection.
 - c. Phase imbalance protection.
 - d. Ambient temperature insensitive.
 - e. Thermal memory.
 - f. Trip test function.
- 2.4 MOTOR CONTROL ACCESSORIES
- A. Auxiliary Contacts:
1. Comply with NEMA ICS 5.

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2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking , plus one normally open (NO) and one normally closed (NC) spare contact for each magnetic motor starter, minimum.
- B. Pilot Devices:
1. Comply with NEMA ICS 5; heavy-duty type.
 2. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
 3. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
 4. Indicating Lights: Push-to-test type unless otherwise indicated.
 5. Provide LED lamp source for indicating lights and illuminated devices.
- C. Control Power Transformers:
1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices, plus 25 VA spare capacity.
 2. Include primary and secondary fuses.
- D. Control Terminal Blocks: Include 25 percent spare terminals.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that ratings of enclosed motor controllers are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed motor controllers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install motor controllers in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment components in accordance with Section 26 0529.
- E. Install enclosed motor controllers plumb and level.
- F. Provide grounding and bonding in accordance with Section 26 0526.
- G. Install all field-installed devices, components, and accessories.
- H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- I. Set field-adjustable motor controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.
- J. Identify enclosed motor controllers in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are []
 1. Verify motor-running protection.
 2. Perform insulation-resistance tests on all control wiring with respect to ground.
- D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers larger than 60 amperes. Tests listed as optional are not required.
- E. Correct deficiencies and replace damaged or defective enclosed motor controllers or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

ENCLOSED CONTROLLERS

3.5 CLEANING

- A. Clean dirt and debris from motor controller enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

3.6 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 proper operation of motor controllers to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of enclosed motor controllers and associated devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.

3.7 PROTECTION

- A. Protect installed enclosed motor controllers from subsequent construction operations.

END OF SECTION 26 29 13

SECTION 26 32 00 – PACKAGED GENERATOR ASSEMBLIES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. PACKAGED ENGINE GENERATOR SYSTEM.
- B. ACCESSORIES
- C. AUTOMATIC TRANSFER SWITCH

1.2 SUBMITTALS:

- A. Manufacturer's Data: Submit copies of manufacturer's specifications and product data for products to be used including:
 - 1. Computer generated, dimensioned installation drawings of the generator set being provided including weight and rigging information, floor plan arrangement showing anchoring details, clearances, accessory locations, elevation views and sections. Indicate the locations of all piping connections, stub-up locations, electrical and control connections, pumps, heaters, valves, gauges, etc.
 - 2. Drawings and/or literature describing auxiliary equipment to be furnished.
 - 3. A schematic diagram of control and alarm circuits including potential and current transformer circuits.
 - 4. Complete wiring diagrams including all field-wiring connections between the generator, transfer switchgear and other remote devices.
 - 5. Material and component lists with component manufacturer and catalog number including types of meters and engine gauges.
 - 6. Physical dimensions and construction details of the equipment.

1.3 QUALITY ASSURANCE:

- A. Manufacturer: The complete system(s) shall be engineered, fabricated, tested, delivered, and warranted by one source. Manufacturer of the Engine-Generator set shall be responsible for the entire system.
- B. The Vendor shall be an authorized factory distributor with the engine-generator set manufacturer. The Vendor shall have a complete set of parts and service availability with the factory certified technician and mechanics available 24 hours per day, 7 days per week. The Vendor shall provide the name, address, and phone numbers of the nearest agency that will provide normal and emergency service.
- C. All Equipment, material, work, and testing supplied shall be in accordance with the latest edition and amendments of all applicable standards, codes, laws and regulations listed:
 - 1. American National Standards Institute (ANSI)
 - 2. National Electrical Code (NEC)
 - 3. National Fire Protection Association (NFPA)
 - 4. Underwriters Laboratory, Inc. (UL), Standard 2200

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5. Institute of Electrical and Electronic Engineers (IEEE)
6. National Electrical Manufacturers Association (NEMA)
7. American Society of Mechanical Engineers (ASME), B-16.5, Steel pipe flanges and Flanged fittings
8. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
9. ASHRAE handbook, HVAC Applications, Chapter 42, "Sound and Vibration Control"
10. American Society of Testing and Materials (ASTM), D975 - Specification for Diesel Fuel
11. Federal, State, and Local codes and Laws
12. Environmental Protection Agency (EPA)
13. Local and State Air Quality Boards (if applicable)

1.4 WORK DESCRIPTION:

- A. This section covers and is applicable only when a standby generator is a part of the work. All equipment necessary for a fully operational power supply shall be included. Size of unit shall be as indicated on the contract drawings and rated on the standby capacity.

1.5 SCOPE:

- A. Provide natural gas or diesel engine-generator set (as prescribed by the site conditions) of the latest commercial type and design with controls and all accessories necessary for a complete installation.
- B. The finished unit shall comply in all respects with all applicable trade standards and all federal, state, county and municipal ordinances, rules and regulations including compliance with noise criteria, emissions requirements, and seismic zoning.
- C. All equipment shall be new, of current production of a national firm, which manufactures and packages the diesel engine-generator set as a unit. The manufacturer/packager together with its authorized representative shall have full responsibility for the performance of the diesel engine-generator set, control, equipment and its accessories.
- D. The terms "generator," "generator set" or similar terms refer to a packaged assembly consisting of the engine-generator set, controls, instrumentation and all accessories (i.e. radiator, silencer, batteries, charger and fuel oil day tanks and pumps) for a complete automatic-start, standby power generator system, exclusive of the generator transfer switchgear.

1.6 DELIVERY, STORAGE AND HANDLING:

- A. The generator set manufacturer shall at all times protect the generator set from adverse environmental conditions during manufacturing, factory testing, storage and shipping. Deliver the Engine-Generator set and system components to their final locations in weatherproof protective wrappings, containers and other protection to prevent damage from construction operations. Ship via direct carrier to the job site.

1.07 OPERATING ENVIRONMENT:

- A. The equipment shall be designed and rated for installation at 1000 feet above sea level with a maximum incoming radiator ambient temperature of 122 °F and a minimum of minus 20 °F. Vendors shall provide de-rating curves up to 12,000 MSL (mean sea level).

1.08 RATING:

- A. Rating standby power rating 400 kW, 500 kVA, at 0.8 power factor, 480Y/277V, 3 phase, 4 wire, 60 Hz.
- B. The rating of the engine-generator set shall be based on operation of the set when equipped with all operating accessories such as radiator fan, exhaust silencer, air cleaners, lubricating oil pump, fuel pump, jacket water pump, governor, charging generator, etc.
- C. The engine-generator set shall be capable of accepting 100% of rated load at 0.8-power factor, lagging, continuously during power failure conditions. The output voltage shall be 480Y/277 volts, 3 phase, 4 wire, wye, 60 Hz.
- D. The generator accepts full rated load in a single step in accordance with NFPA 110 Type 10 (ten seconds) for Level 1 and Level 2 Emergency operation.
- E. Performance criteria are based on the continuous standby rating.

1.09 INSTALLATION WIRING DOCUMENTS:

- A. In addition to the record submittal documents, the generator set manufacturer/bidder shall prepare for the Contractor's use and submit to the Engineer for review, equipment wiring single line drawings showing all control and power conductors required to or between each item of equipment in the generator plant. This drawing shall detail the quantity, type and size of each conductor required for the installation of the generator set, day tanks, chargers, pumps and annunciators. Installation wiring drawings shall be submitted along with the record submittal documents.

1.10 WARRANTY:

- A. The bidder shall advise their warranty period for the complete generator set against defects in workmanship and material. The warranty shall be comprehensive and cover parts and labor for all components, wiring, and performance of the generator set. Multiple warranties for individual components (e.g., engine, alternator, controls, etc.) are unacceptable. Diminishing component count warranties or warranties that exclude parts or labor after a fraction of the warranting time are not acceptable. Satisfactory warranty documents shall be provided. The manufacturer/bidder shall guarantee consistency in materials, components, assembly, and workmanship.
- B. Warranty begins at successful completion of the on-site live load test.

1.11 STARTUP:

- A. The engine-generator supplier shall provide complete startup service including technicians, load banks, cables, instruments and documentation.
- B. Coordinate startup of the generator sets with startup and testing of the generator transfer switchgear.
- C. Provide service, exclusive of other start-up duties, for the verification of alarms to the building EMS panel.

1.12 OPERATION AND MAINTENANCE MANUALS:

- A. The manufacturer/bidder shall provide three (3) sets of Operating and Maintenance Manuals. Manuals shall be indexed with tabular pages. Manuals shall be bound in heavy-duty three ring binders. Binding holes or individual pages shall be reinforced. Oversize drawings shall be arranged to fold out of the binder without being removed. All manufacturers' printed literature enclosed shall be original or clearly legible copies. Manuals shall include:
 - 1. System description and drawings (shop drawings where applicable)
 - 2. Sequence of operation, operating instruction and recommendations customized to configuration of this project

3. Maintenance instructions including recommendations for oil type, fluid and filter change frequency, oil sampling, or other factory-recommended routine and preventive maintenance
4. Parts list
5. Descriptive literature
6. Location and telephone numbers of authorized service agent
7. Copies of all test reports and certifications required elsewhere in this Specification
8. Letter of Warranties for all equipment furnished

PART 2 - PRODUCTS

2.01 GENERAL:

- A. All equipment furnished shall be the responsibility of the engine-generator manufacturer/bidder.

2.02 MATERIALS:

A. ENGINE:

Certified engine horsepower curves shall be submitted showing the manufacturer's approval of the engine rating for generator standby power application based on actual testing of a similar package. Special ratings or "maximum" ratings will not be acceptable. Allow for power required to drive radiator fan sized for external pressure drop, as well as other engine-driven accessories.

B. FUEL SOURCE

1. Engine will operate with natural gas.
2. The consulting engineer shall verify the Btu content of the local natural gas source is sufficient for generator usage. Confirm the acceptance of natural gas as a fuel source with the consulting engineer.
3. NATURAL GAS:
 - a. The naturally aspirated engine shall be fueled with natural gas and be supplied with a unit-mounted electric solenoid fuel shut-off valve, flexible fuel line, and secondary fuel pressure regulator.
 - b. The engine shall have a minimum of 6 cylinders and be liquid-cooled by a unit-mounted radiator, blower fan, water pump, and thermostats. This system shall properly cool the engine with up to 0.5 inches H₂O static pressure on the fan in an ambient temperature up to 122F/50C.
 - c. The engine shall be equipped with:
 - 1) Hydraulic governor capable of 5.0% steady-state frequency regulation.
 - 2) 12 Volt positive engagement solenoid shift-starting motor.
 - 3) 70-Ampere minimum automatic battery charging alternator with solid-state voltage regulation.
 - 4) Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.
 - 5) Dry-type replaceable air cleaner elements for normal applications.

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C. COOLING: Shall be glycol mix or as recommended by the manufacturer with a unit mounted radiator.

D. LUBRICATION:

1. The engine shall have a gear-type lubrication oil pump for supplying oil under pressure to the main bearings, turbocharger (if required), crankpin bearings, pistons, piston pins, timing gears, camshaft bearings, and valve rocker mechanism.
2. Threaded, spin-on type, replaceable full flow lubricating oil filters conveniently located for servicing shall be provided. Filters shall be equipped with a spring loaded, pressure calibrated bypass valve to insure oil circulation if filters are clogged.
3. Crankcase lubrication oil pan capacity shall be sufficient to permit at least 150 hours of operation on one filling after the break-in period under normal operating conditions.
4. Provide valved oil pan drain extended to a threaded connection located outside the engine rails for easy servicing.
5. All flexible oil lines shall be as short as practicable. The flexible oil lines with hose clamp fittings are not acceptable.

E. STARTING: Shall be 12V or as required by manufacturer from remote battery system.

F. ALTERNATOR

1. The alternator shall be permanent magnet brushless design.
2. The alternator shall be salient-pole, brushless, 12-lead reconnectable, self-ventilated of drip-proof construction with amortisseur rotor windings and skewed stator for smooth voltage waveform. The insulation shall meet the NEMA standard (MG1-33.40) for Class H and be insulated with epoxy varnish to be fungus resistant per MIL 1-24092. Temperature rise of the rotor and stator shall be limited to 130°C.
3. The excitation system shall have brushless construction controlled by a solid-state voltage regulator capable of maintaining voltage within +/- 2% at any constant load from 0% to 100% of rating. The regulator must be isolated to prevent tracking when connected to SCR loads, provide individual adjustments for voltage range, stability and volts-per-hertz operations, and be protected from the environment by conformal coating.
4. The generator set shall meet the transient performance requirements of ISO 8528-5, G-2.
5. The generator shall be inherently capable of sustaining at least 250% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current support devices.
6. The alternator having a single maintenance-free bearing, shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel. Gear or belt driven alternators are not permitted.

G. SUB-BASE/HOUSING:

1. Provide sub-base suitable for mounting the stand by generator unit on a concrete pad. Provide vibration dampening between the generator unit and the sub-base. In all cases provide a rubber vibration pad between the sub base and concrete pad and anchor with non-corroding bolts. Remember to install 4-inch housekeeping pad on the concrete pad.
2. Standby generator for installation outdoors shall be provided with vandal resistant, Level 2 sound-attenuated and weatherproof housing. Where unit is located within 1000 ft. of a residential area, housing to be provided with critical silencing devices to reduce noise output to 75 DBA (average) at a distance of 7 meters from the unit.

H. CONTROL PANEL:

1. The generator set shall be provided with a microprocessor-based control system to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set and remote monitoring at the transfer switch.
2. The controls shall be mounted on the generator set. The controls shall be vibration isolated and tested to verify the durability of all components in the system under the vibration conditions encountered.
3. Controls:
 - a. Three-position control switch labeled RUN/OFF/AUTO. In the RUN position the generator set shall automatically start and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - b. Red “mushroom-head” push-button EMERGENCY STOP switch. Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.
 - c. RESET switch shall be used to clear a fault and allow restarting the generator set after it has been shut down for any fault condition.
 - d. Alarm and Status Indicators (Local): The generator set shall be provided with alarm and status indicating lamps to indicate generator status, existing alarms, and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The indicator lamps shall illuminate alarms and status per:
 - 1) Water Temperature Gauge with high temperature cut-out and signal light.
 - 2) Oil Pressure Gauge with low pressure cut-out and signal light.
 - 3) Automatic Over-Speed Shutdown and Signal Light.
 - 4) Cranking Limiter and Signal Light.
 - 5) Mainline Circuit Breaker manual re-set.
 - 6) AC Voltmeter and Selector Switch with positions for phase-to-phase and phase-to-neutral readings.
 - 7) AC Ammeter and Selector Switch with positions for phase-to-phase and phase-to-neutral readings.
 - 8) Frequency and Running Time Meter.
 - 9) Rheostat for voltage adjustment.
4. Controls shall be provided to monitor the output current of the generator set. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.
5. Controls shall be provided to monitor the kW load on the generator set and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.

2.04 AUTOMATIC TRANSFER SWITCH:

A. SWITCH ASSEMBLY

1. Shall be a 4-pole, 60 HZ, electrically operated, mechanically held assembly, break before make operation.
2. The current rating shall be at least equal to the full load current of the generator.

3. Shall be enclosed in a suitable NEMA-1 enclosure and shall be UL approved. It shall include an auxiliary contact to indicate when the load is on standby operation.
4. 3-Position selector switch shall be provided with indicator lights mounted on the face of the enclosure to indicate the source of power supply (green-normal, red-generator) for:
 - a. Automatic.
 - b. Stop.
 - c. Test or Exercise. Generator to assume load in this position.

B. CONTACTS:

1. Main Contacts shall be rated to withstand all available short circuit currents and to allow for inrush currents 15 times continuous rating. Main contacts shall be silver-plated and suitable to carry both inductive and non-inductive loads. All main contacts shall be of silver composition. The main contacts shall be protected by arcing contacts in sizes 400 amperes and above. The main contacts shall be of the blow-on configuration and of segmented construction in ratings 600 amperes and above.
2. All contacts, coils, springs, and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors.
3. All contacts, coils, springs, and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors.

C. CONTROLS

1. The control module shall direct the operation of the transfer switch. The module's sensing and logic shall be a built-in microprocessor-based system for maximum reliability, minimum maintenance, and inherent digital communications capability. The control settings shall be stored in nonvolatile EEPROM. The module shall contain an integral programmable clock and calendar. The control module shall have a keyed disconnect plug to enable the control module to be disconnected from the transfer mechanism for routine maintenance.
2. The control module shall be mounted separately from the transfer mechanism unit for safety and ease of maintenance. Interfacing relays shall be industrial control grade plug-in type with dust cover.
3. The control module shall include programming keypad, alphanumeric display for monitoring settings and diagnostic values, key-lockable program selector switch, light-emitting diode status indication, and user instructions. These features shall be user accessible when the enclosure door is closed.
4. Power outage or voltage drop of any phase below 70% shall start the plant. Power line return or voltage on all phases at 90% shall retransfer load to the normal source.
5. Time Delays (adjustable):
 - a. Start = Range 0-6 seconds. Factory set at 5 seconds
 - b. Stop = Range 0-30 minutes. Factory set at 5 seconds
 - c. Transfer = Range 0-5 minutes. Factory set at 5 seconds
 - d. Re-Transfer = Range 0-30 minutes. Factory set at 5 seconds
6. The control module shall be capable of storing records in memory for access locally.

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- a. Number of hours transfer switch is in the emergency position (total and since record reset)
 - b. Number of hours the emergency is available (total and since record reset)
 - c. Total days that control has been energized (total and since record reset)
 - d. Total transfers in either direction (total and since record reset)
 - e. Date of record reset
 - f. Date of last exercise period
 - g. Date, time, and description of the last four source failures
 - h. Elapsed time during the most recent source outage
7. Light-emitting diodes shall indicate the status of the following:
- a. Contactor Position
 - b. A lamp test push button shall light all light-emitting diodes.
 - c. System Status
 - d. Transfer Switch Position Sensing Fault
 - e. Transfer Switch Fail to Transfer
 - f. Internal Control Module Fault
 - g. Manual Transfer Operation
 - h. External Fault Condition (two inputs)
 - i. Not In Automatic
 - j. Programming Switch Not In Off
 - k. The system status messages shall also be shown on the alphanumeric display.
- D. Operation:
1. All phases of normal and emergency power shall be monitored for under and over voltage. The controller shall use anti-single phasing protection detecting regenerative voltage to determine a failed source condition.
 2. The user shall have the ability to manually program an engine start and run for a period of up to 72 hours in the loaded or unloaded mode of operation. The time delay transfer to emergency and/or normal may be bypassed during the run period. A numeric indication shall be displayed of the run time remaining in hours and minutes. The run period may be stopped at any time with a single keystroke. After the run period has stopped, the engine shall run unloaded for the cool down time.
- E. Plant Exerciser: Programmable seven-day, fourteen-day or calendar exerciser. Each exerciser mode shall be capable of performing up to two exercise runs in up to five exercise event periods. The exercise period shall be programmed with the enclosure door closed. The exercise time may be reset at any time with a single keystroke. The engine shall be allowed to run when the exercise period is terminated.

2.05 ACCESSORIES:

- A. Battery: Shall be of proper size with solid state battery charger (independent of engine), steel battery rack, and battery cables. The battery shall be standard of the engine generator manufacturer.
- B. Jacket Water Heater – UL approved with thermostat and shut-off valves.
- C. A 100% rated line circuit breaker of 600 amperes, 600 volt rated, molded case type, generator mounted.
- D. A resettable line current sensing circuit breaker with inverse time versus current response shall be furnished which protects the generator from damage due to its own high current capability. This breaker shall not trip within the 10 seconds specified above to allow selective tripping of down-stream fuses or circuit breakers under a fault condition. This breaker shall not automatically reset, preventing restoration of voltage if maintenance is being performed. A field current-sensing breaker will not be acceptable.
- E. Weather housings shall be constructed of G60 galvanized high strength, low alloy steel, cleaned, phosphated, and electrocoat painted inside and out with rust inhibiting primer and exterior coat of the manufacturer's standard color. Enclosure shall allow the generator to operate at full load at 40°C ambient with no derating of electrical output. Enclosure shall meet UL-2200. Side panels will be lockable and stainless steel hinged for servicing. Exhaust system to be internal to the enclosure. Roof mounted or external silencers are not acceptable.
- F. Six ampere automatic float and equalize battery charger with +/- 1% constant voltage regulation from no load to full load over +/-10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambient temperatures from -40°C to +60°C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected.
- G. The single relay dry contact kit provides normally open and normally closed contacts in a form C configuration to activate warning devices and other customer provided accessories allowing remote monitoring of the generator set. Typically, lamps, audible alarms, or other devices signal faults or status conditions.
- H. Common Failure relay to remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and overspeed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. The STANDBY GENERATOR set shall be installed as noted on the contract drawings. Under no circumstances shall any components including but not limited to panelboards, transfer switches, fuel pump and fuel piping be located in the main switchboard room.
- B. ALL MECHANICAL WORK shall be installed in total conformance to the applicable sections of these specifications, drawings and code regulations.
- C. Install generator on 4" high concrete housekeeping pad. Install rubber vibration pads between skid and concrete pad, anchoring to pad with non-corrosive bolts, and a flexible grounding strap. If generator has internal spring isolation, vibration pads are not required.
- D. Secure proper amount of air exchange for combustion and cooling with requirements provided to the appropriate Mechanical Contractor.
- E. For interior located units, coordinate and install control wiring and connections from engine controller to exhaust damper controller such that the damper is in full open position during which time the unit is in RUN mode.

3.02 FUEL OIL SYSTEM:

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- A. The contractor shall test and install the system per the manufacturer's recommendations.
- B. Immediately before installation, test the tank for leakage with an air test to 5 psi. Monitor the pressure for 30 minutes. Soap the tank and check for leaks.
- C. Provide anchors per the manufacturer's recommendations.
- D. All threaded fittings shall withstand a minimum of 140 foot pounds of torque and 1,000 foot-pounds of bending.
- E. The installer must be certified by the tank and pipe manufacturers.

3.03 OIL LINE TIGHTNESS TEST:

- A. Oil lines shall be tested after installation and before the piping is connected to the burner equipment.
- B. The suction piping shall be tested hydrostatically under air pressure at 2 times the maximum system working pressure or tested under a vacuum of not less than 20" of mercury.
- C. All pressure or vacuum tests should continue for not less than one (1) hour. If there is no noticeable drop in the initial pressure or vacuum test, the lines can be considered tight.

3.04 ON SITE TESTING:

- A. Before acceptance of the standby generator set, an entire system test shall be performed. If for any reason the 4-hour load bank test is terminated, the entire 4-hour test shall be restarted until satisfactory results are obtained. If satisfactory results are not obtained because of installation errors, the installing contractor will be responsible for all retesting charges including labor, materials and transportation.
- B. The engine-generator Vendor shall provide qualified personnel, test equipment, cable, etc., for system test.
- C. Before site testing, the vendor shall provide certification stating equipment has not been exposed to adverse environmental conditions.
- D. Prior to the load test, all functions and safeties shall be tested:
 - 1. Verification of the proper operation of safety shutdowns
 - 2. Verification of all alarms (local and remote)
 - 3. Verification of all control functions (automatic and manual)
 - 4. Verification of proper interfaces and control with the transfer switchgear including proper engine starting controls and safeties
 - 5. Verify proper operation of all motor controlled louvers, shutters and ventilation fans
- E. Load Tests:
 - 1. Unless otherwise noted, all load tests specified to be performed at the factory shall be repeated during the site test including cold-start step-load test and transient tests. Provide 4-hour field load bank test.
 - 2. Tests shall be performed as specified above for factory testing.

3.05 FUEL AND CONSUMABLES:

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- A. The engine-generator vendor shall provide all lubricating oil, coolant, lubricants and filters and other incidental consumables required for generator set testing and for switchgear testing.
- B. The General Contractor shall provide fuel for testing including top off after all testing.
- C. After the completion of testing, all lubricating and cooling fluid levels shall be topped off.
- D. Oil and filters shall be changed in the event of abnormally long testing.

3.06 SERVICE:

- A. Adjust all components of the system for proper operation while system is subjected to load testing at job site and prior to the operation demonstration.
- B. Provide one 4-hour full day operation demonstration and instruction with JCPenney representatives and the manufacturer's service personnel present.
- C. Provide an inspection of the engine-generator after 180 days of acceptance and full unit servicing including a complete oil change.

END OF SECTION 26 32 00

SECTION 26 43 00 - SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surge protective devices for service entrance locations.
- B. Surge protective devices for distribution locations.
- C. Surge protective devices for branch panelboard locations.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 2416 - Panelboards.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 1283 - Standard for Electromagnetic Interference Filters; Current Edition, Including All Revisions.
- F. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.
- C. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
- D. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.
- E. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL).

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.7 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

- B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Square D.
- B. Factory-installed, Internally Mounted Surge Protective Devices:
 - 1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.
- C. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.2 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
- B. Protected Modes:
 - 1. Wye Systems: L-N, L-G, N-G, L-L.
- C. UL 1449 Voltage Protection Ratings (VPRs):
 - 1. Equivalent to basis of design.
- D. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
- E. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
- F. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.
 - 1. Panelboards: See Section 26 2416.

2.3 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

- A. Unless otherwise indicated, provide factory-installed, internally mounted SPDs.
- B. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
- C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
- D. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.
- E. UL 1449 Nominal Discharge Current (I-n): 20 kA.
- F. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
- G. Diagnostics:
 - 1. Protection Status Monitoring: Provide indicator lights to report the protection for each phase.
 - 2. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
- H. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.4 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

- A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
- B. List and label as complying with UL 1449, Type 1 or Type 2.
- C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
- D. Surge Current Rating: Not less than 80 kA per mode/160 kA per phase.
- E. UL 1449 Nominal Discharge Current (I-n): 20 kA.
- F. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

- G. EMI/RFI Filtering: Provide EMI/RFI filter to attenuate electrical noise; listed as complying with UL 1283 for Type 2 SPDs (UL 1283 listing not available for Type 1 SPDs).
- H. Diagnostics:
 - 1. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.
 - 2. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
 - 3. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.
- I. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.5 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

- A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
- B. List and label as complying with UL 1449, Type 1 or Type 2.
- C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
- D. Surge Current Rating: Not less than 60 kA per mode/120 kA per phase.
- E. UL 1449 Nominal Discharge Current (I-n): 20 kA.
- F. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
- G. Diagnostics:
 - 1. Protection Status Monitoring: Provide indicator lights to report the protection status.
 - 2. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
 - 3. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.
- H. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
- C. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1.
- B. Install SPD in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.
- E. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.
- F. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

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3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Section 7.19.1.

3.4 CLEANING

- A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 43 00

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.
- E. Luminaire accessories.

1.2 RELATED REQUIREMENTS

- A. Section 26 0537 - Boxes.
- B. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
- C. Section 26 2726 - Wiring Devices: Manual wall switches and wall dimmers.
- D. Section 26 5600 - Exterior Lighting.

1.3 REFERENCE STANDARDS

- A. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; Illuminating Engineering Society; 2008.
- B. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2006.
- E. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 101 - Life Safety Code; 2015.
- H. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- I. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- J. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

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1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting) and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.
- B. Substitutions: See Section 01 6000 - Product Requirements, except where individual luminaire types are designated with substitutions not permitted.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
 - 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.3 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery: As Scheduled on the Drawings.
 - 1. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- F. Accessories:
 - 1. Provide compatible accessory mounting brackets where indicated or required to complete installation.

2.4 EXIT SIGNS

- A. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single or double as indicated or as required for the installed location.
 - 2. Directional Arrows: As indicated or as required for the installed location.
- B. Self-Powered Exit Signs:
 - 1. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
 - 2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.
 - 3. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
 - 4. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.5 BALLASTS AND DRIVERS

- A. Dimmable LED Drivers:
 - 1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
 - 2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.6 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA 500 (commercial lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 - 4. Secure pendant-mounted luminaires to building structure.
 - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
 - 7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- F. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- G. Suspended Luminaires:
 - 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 - 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.

3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet in length, with no more than 4 feet between supports.
 4. Install canopies tight to mounting surface.
 5. Unless otherwise indicated, support pendants from swivel hangers.
- H. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- I. Install accessories furnished with each luminaire.
- J. Bond products and metal accessories to branch circuit equipment grounding conductor.
- K. Emergency Lighting Units:
1. Unless otherwise indicated, connect unit to un-switched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
 2. Install lock-on device on branch circuit breaker serving units.
- L. Exit Signs:
1. Unless otherwise indicated, connect unit to un-switched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
 2. Install lock-on device on branch circuit breaker serving units.
- M. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- 3.4 FIELD QUALITY CONTROL
- A. See Section 01 4000 - Quality Requirements, for additional requirements.
 - B. Inspect each product for damage and defects.
 - C. Operate each luminaire after installation and connection to verify proper operation.
 - D. Test emergency lighting units to verify proper operation upon loss of normal power supply.
 - E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.
- 3.5 ADJUSTING
- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
 - B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.
 - C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.
- 3.6 CLEANING
- A. Clean surfaces according to NECA 500 (commercial lighting) and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
- 3.7 PROTECTION
- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 51 00

SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Exterior luminaires.
- B. Ballasts.
- C. Lamps.
- D. Poles and accessories.
- E. Luminaire accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 37 - Boxes.
- D. Section 26 09 23 - Lighting Control Devices
- E. Section 26 27 26 - Wiring Devices: Receptacles for installation in poles.
- F. Section 26 28 13 - Fuses.
- G. Section 26 51 00 - Interior Lighting.

1.3 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. IEEE C2 - National Electrical Safety Code; 2012.
- C. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Cor 1, 2012).
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- E. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2006.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.
- H. UL 1029 - High-Intensity-Discharge Lamp Ballasts; Current Edition, Including All Revisions.
- I. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- J. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
 - 2. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:

1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
 - C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.
 3. Lamps: Include rated life and initial and mean lumen output.
 4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
 - D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
 - E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
 - F. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.
- 1.6 QUALITY ASSURANCE
- A. Conform to requirements of NFPA 70.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
 - B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
 - C. Receive, handle, and store wood poles in accordance with ANSI O5.1.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Provide products complying with Federal Energy Management Program (FEMP) requirements.
- E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- H. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- I. LED Luminaires:
 1. Components: UL 8750 recognized or listed as applicable.
 2. Tested in accordance with IES LM-79 and IES LM-80.
 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.3 POLES

A. All Poles:

1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
2. Material: Steel, unless otherwise indicated.
3. Shape: Round straight, unless otherwise indicated or scheduled.
4. Finish: Match luminaire finish, unless otherwise indicated.
5. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.

B. Metal Poles: Provide ground lug, accessible from handhole.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Pole-Mounted Luminaires:
 1. Foundation-Mounted Poles:
 - a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 3000.
 - 1) Install anchor bolts plumb per template furnished by pole manufacturer.
 - 2) Position conduits to enter pole shaft.
 - b. Install foundations plumb.
 - c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
 - d. Tighten anchor bolt nuts to manufacturer's recommended torque.
 - e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
 - f. Install anchor base covers or anchor bolt covers as indicated.
 2. Grounding:
 - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
 - b. Provide supplementary ground rod electrode as specified in Section 26 0526 at each pole bonded to grounding system as indicated.
 3. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
 4. Install non-breakaway in-line fuse holders and fuses complying with Section 26 2813 in pole handhole for each ungrounded conductor.
- F. Install accessories furnished with each luminaire.

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- G. Bond products and metal accessories to branch circuit equipment grounding conductor.
- H. Install lamps in each luminaire.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect.

3.6 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 56 00

SECTION 28 31 00 – ADDRESSABLE FIRE ALARM SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes fire alarm control panels, manual fire alarm stations, automatic smoke and heat detectors, fire alarm signaling appliances, elevator recall, supervision of power for area of rescue power supply, auxiliary fire alarm equipment and power and signal wire and cable.

1.2 REFERENCES

- A. International Building Code – 2021 Edition
- B. National Fire Protection Association:
 - 1. NFPA 20 - Standard for the Installation of Stationary Fire Pumps for Fire Protection.
 - 2. NFPA 70 National Electrical Code – 2021
 - 3. NFPA 72 - National Fire Alarm and Signaling Code - 2021 Edition.
 - 4. NFPA 101 – Life Safety Code – 2021
 - 5. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.3 SYSTEM DESCRIPTION

- A. Fire Alarm System: NFPA 72, fully functional manual and automatic supervising station fire alarm system. Connect to owner approved remote station.
- B. Alarm Sequence of Operation: Actuation of initiating device causes the following system operations:
 - 1. Local fire alarm signaling devices sound and display with march time signal.
 - 2. Zone-coded signal transmits to receiving station.
 - 3. Location of alarm zone indicates on fire alarm control panel and on remote annunciator panel.
- C. Drill Sequence of Operation: Manual drill function causes alarm mode sequence of operation.
- D. Supervisory Sequence of Operation: Supervisory signal causes the following system operations:
 - 1. Visual and audible supervisory alarm indicates by device at fire alarm control panel.
 - 2. Visual and audible supervisory alarm indicates by device at remote annunciator panel.
 - 3. Supervisory signal transmits to remote station.
- E. Trouble Sequence of Operation: System or circuit trouble causes the following system operations:
 - 1. Visual and audible trouble alarm indicates by zone at fire alarm control panel.
 - 2. Visual and audible trouble alarm indicates at remote annunciator panel.
 - 3. Trouble signal transmits to remote station.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate system wiring diagram showing each device and wiring connection; indicate annunciator layout, and design calculations. Fully comply with Section 7.4 of NFPA 72.
- B. Product Data: Submit catalog data showing electrical characteristics and connection requirements for all devices and equipment. Include listing agency data for devices and equipment. Fully annotate all data sheets and listing agency data with specific models.
- C. Test Reports: Indicate procedures and results for specified field testing and inspection.

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- D. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Drawings: Comply with Section 7.5.5 of NFPA 72 and record actual locations of all fire alarm equipment and circuit runs. Include Record of Completion as noted in Section 7.5.6
- B. Operation and Maintenance Data: Submit manufacturer's standard operating and maintenance instructions.

1.6 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience, and compatible with the existing system.
- B. Installer shall be licensed for work under the scope of this specification with 5 years experience and a current NICET level III certificate in fire alarm systems.

1.8 MAINTENANCE MATERIALS

- A. Furnish six keys of each type.

1.9 EXTRA MATERIALS

- A. Furnish three of each type of automatic smoke detector
- B. Furnish three of each type of notification appliance

PART 2 PRODUCTS

2.1 CONTROL PANEL

- A. Product Description: Modular fire alarm control panel with surface wall-mounted enclosure.
- B. Power supply: Adequate to serve control panel modules, remote detectors, remote annunciators, smoke dampers, relays, and alarm signaling devices. Include battery-operated emergency power supply with capacity for operating system in standby mode for 24 hours followed by alarm mode for 5 minutes.
- C. System Supervision: Component or power supply failure places system in trouble mode.
- D. Initiating Device Circuits: Supervised zone module with alarm and trouble indication; occurrence of single ground or open condition places circuit in trouble mode but does not disable circuit from initiating alarm.
- E. Indicating Appliance Circuits: Supervised signal module, sufficient for signal devices connected to system; occurrence of single ground or open condition places circuit in trouble mode but does not disable circuit from signaling alarm.
- F. Remote Station Signal Transmitter: Electrically supervised, capable of transmitting alarm and trouble signals over telephone lines to central station receiver.

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- G. Auxiliary Relays: Sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions specified.
- 2.2 NAC EXTENDER PANELS.
- A. Provide panels compatible with the installed system and capable of communicating on the SLC.
- 2.3 MANUAL FIRE ALARM STATIONS
- A. Product Description: Manual double-action station.
 - B. Mounting: Semi-flush.
 - C. Type: Addressable.
 - D. Backbox: Manufacturer's standard.
- 2.4 CEILING SMOKE DETECTOR
- A. Product Description: NFPA 72, ionization type ceiling smoke detector with the following features:
 - 1. Adjustable sensitivity.
 - 2. Plug-in base.
 - 3. Auxiliary relay contact.
 - 4. Visual indication of detector actuation.
 - 5. Comply with UL 268.
 - B. Mounting: 4 inch outlet box.
 - C. Furnish two-wire detector with common power supply and signal circuits.
- 2.5 Duct Detectors.
- A. Photo Electric type complying with UL 268A.
 - 1. Detector address shall be accessible from fire alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. Provide normal-reset-test stations on the wall under units. Mark each station with HVAC unit number.
- 2.6 Audio Visual Devices
- A. Provide factory integrated audible and visible devices in a single mounting assembly equipped for mounting as indicated with screw terminals for system connections marked "Fire".
- 2.7 Visual Devices.
- A. Provide visual devices with a clear high intensity optic lens, xenon flash tubes, or light emitting diode (LED) and marked "Fire". Where strobes and horns are provided at the same location, provide a single combined unit. All strobes shall be synchronized.
- 2.8 REMOTE ANNUNCIATOR
- A. Product Description: Supervised remote annunciator with control features same as the fire alarm control panel. Include audible and visual indication of fire alarm by device, and audible and visual indication of system trouble. Coordinate location with owner at receptionist's desk.
 - B. Mounting: Factory mounted in surface wall-mounted enclosure. Maximum reveal of 4 inches.

2.9 WIRE AND CABLE

- A. Product Description: Non-power limited fire-protective signaling cable, copper conductor, 150 volt insulation rated 60 degrees C.
- B. Stranded conductors not allowed.
- C. Cable Located Exposed in Plenums: Power limited fire-protective signaling cable classified for fire and smoke characteristics, copper conductor, 300 volts insulation rated 105 degrees C, suitable for use in air handling ducts, hollow spaces used as ducts, and plenums.
- D. Fire alarm circuit conductors have insulation color or code as follows:
 - 1. Power Branch Circuit Conductors: Black, red, white
 - 2. Initiating Device Circuit: Black, red.
 - 3. Detector Power Supply: Violet, brown.
 - 4. Signal Device Circuit: Blue (positive), white (negative).
 - 5. Door Release: Gray, gray.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify products and systems receiving devices are ready for installation.

3.2 INSTALLATION

- A. Install manual station with operating handle 44-48 inches above floor.
- B. Install audible and visual signal devices 7 feet 6 inches above floor.
- C. Install 16 AWG minimum size conductors for fire alarm detection and signal circuit conductors in conduit.
- D. Mount end-of-line device in control panel.
- E. Connect conduit and wire to all devices
- F. Automatic Detector Installation: Conform to NFPA 72.
- G. Install engraved plastic nameplates
- H. Ground and bond fire alarm equipment and circuits
- I. All circuits to be run in a minimum of ¾ inch conduit with a factory applied red finish.
- J. All circuits shall be terminated in devices or panels on screw terminals. Splicing is not permitted.
- K. Where devices are provided with stranded wire, use blade connectors to connect to screw terminals.

3.3 FIELD QUALITY CONTROL

- A. Test in accordance with NFPA 72 and authority having jurisdiction requirements.

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3.4 MANUFACTURER'S FIELD SERVICES

- A. Include services of certified technician to supervise installation, adjustments, final connections, and system testing.

3.5 DEMONSTRATION AND TRAINING

- A. Furnish 12 hours of instruction (4 hours per shift) each for two persons, to be conducted at project site with manufacturer's representative.

END OF SECTION

SECTION 312010 - EARTH MOVING (SITE)

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.
- B. Documents:
 - 1. Soil borings, site preparation, and pavement recommendations – herein specified as the Geotechnical Report. Copies of report available from Architect's office upon request.
 - a. "Subsurface Exploration and Geotechnical Engineering Report, Proposed The Newtron Group – New Campus Project, Baton Rouge, Louisiana, Premier File No.:21-0020_Final", issued May 19, 2022 by Premier Geotech and Testing, LLC.
- C. All references to LADOTD specifications are to the Louisiana Standard Specifications for Roads and Bridges, 2016 Edition.
- D. Refer to section 312000 "Earth Moving – Building Pad" for earth moving requirements related to proposed building.

1.2 SUMMARY

- A. Section Includes:
 - 1. Excavating and filling for rough grading the Site outside of the building pad.
 - 2. Preparing subgrades for walks, pavements, turf and grasses.
 - 3. Structural fill for concrete pavements.
 - 4. Base course for concrete pavements.
 - 5. Bedding course for utility trenches.
 - 6. Geotextile fabrics.
 - 7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.3 DEFINITIONS

- A. Backfill: Soil 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: Granular layer 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. 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 Engineer. 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 Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

E. Fill: Soil materials used to raise existing grades.

F. Select of Structural Fill: Fill material meeting the criteria established in subsequent sections, and that is suitable for placement beneath areas of proposed pavement.

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: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below base, drainage fill, drainage course, 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: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D698.

B. Laboratory gradation reports for specified base course and bedding course.

1.5 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

1.6 FIELD CONDITIONS

A. Utility Locator Service: Notify Louisiana One Call (811) for area where Project is located before beginning earth-moving operations.

B. Do not commence earth-moving operations until plant-protection measures specified in Section 311000 "Site Clearing" are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils for Select or Structural Fill: Soil Classification CL or SC in accordance with the United Soil Classification System (USCS); inert (non-expansive); free of rock or gravel, debris, waste, frozen materials, vegetation, and other deleterious matter, and with maximum particle size of less than 2 inches. This material shall conform to the following criteria:

1. Liquid Limit: 40 maximum.
 2. Plasticity Index: 12 minimum, 22 maximum.
- C. Satisfactory Soils for Non-Structural Fill: Soils used for fill outside of areas of proposed pavement or other structures shall be free of rock or gravel, debris, waste, frozen materials, and other deleterious matter. This material shall conform to the following criteria:
1. Liquid Limit: 55 maximum.
 2. Plasticity Index: 10 minimum, 40 maximum.
 3. Percent Passing U.S. sieve #200: 12 minimum.
- D. Base Course: Material required beneath areas of concrete pavement shall be blended with in-situ or imported soils, and compacted over the prepared subbase or subgrade.
1. Lime treatment in accordance with LADOTD Standard Specification Section 304 and 1018.02, Type C.
 2. Soil cement in accordance with LADOTD Standard Specification Section 301 and 1018, all referenced sections.
 - a. Cement-treated base course shall yield a minimum compressive strength of 250psi at a 7 day cure time.
- E. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand in accordance with LADOTD Standard Specification Section 1003.10.2.

2.2 GEOTEXTILES

- A. Provide Class 'D' in conformance with LADOTD specification section 1019 and all referenced sections.

2.3 ACCESSORIES

- A. 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 earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. 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. Provide temporary pumping systems to dewater all excavations that become inundated. Dewater within 24 hours of inundation.
 - 3. Install a dewatering system to keep subgrades dry and to convey ground water away from excavations. Maintain until dewatering is no longer required.
- D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Do not discharge sediment-laden water into existing public or private drainage systems.
- E. Remediation of compromised soils resulting from failure to comply with temporary drainage measures shall be performed with no changes in the Contract Sum or the Contract Time.
 - 1. Methods of remediation will be determined by the Geotechnical Engineer.

3.3 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. Excavations at Edges of Tree- and Plant-Protection Zones:
 - 1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- 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: 18 inches on each side of pipe or conduit.

- C. Trench Bottoms: Excavate trenches 6 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
- D. Excavations greater than 4 feet in depth shall require temporary shoring, bracing, or sheeting in lieu of unsupported trench sides.

3.6 SUBGRADE INSPECTION

- A. Notify Geotechnical Engineer when excavations have reached required subgrade.
- B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll all pavement subgrades with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 20 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades. Proof-roll under areas of proposed walks is not required.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in opposite direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Geotechnical Engineer, and remediate as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 1. Deficient areas shall be recorded on a project site plan by the Geotechnical Engineer, with the location and dimensions of the deficient areas indicated. This map shall be provided to the Architect before a change in Work will be considered.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Geotechnical Engineer, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation as directed by the Engineer.

3.8 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.

3.9 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. Initial Backfill: 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 pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Final Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.10 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 of satisfactory soil material is not required.
2. Under walks and under or within 5 feet of pavements, use satisfactory soil material.

C. Place select fill on subgrades free of mud, frost, snow, or ice.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

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 optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. 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.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698:

1. Under pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.13 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.

- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1½ inch.
 - 2. Walks: Plus or minus 1/2 inch.
 - 3. Pavements: Plus or minus 1/4 inch.

3.14 BASE COURSE UNDER PAVEMENTS

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements as follows:
 - 1. Shape base course to required crown elevations and cross-slope grades.
 - 2. Place 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.
 - 3. Compact stabilized subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D698.
 - a. Lime treated base shall be compacted in accordance with LADOTD Standard Specification section 303.11, and all referenced sections and documents.
 - b. Cement stabilized base shall be compacted in accordance with LADOTD Standard Specification section 301.10, and all referenced sections and documents.

3.15 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and the following inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material classification and maximum lift thickness comply with requirements.
 - 3. Determine, during placement and compaction, and at the required frequency, that in-place density of compacted fill complies with requirements.
 - 4. Establish optimum moisture content and stabilization ratios for the sub-base, if required.
 - 5. Recommend remedial measures for areas of unsuitable or unstable soils beneath proposed pavements.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Testing agency will determine classification of soils to be used for select of structural fill in accordance with United Soil Classification System (ASTM D2487). Atterberg Limits for the same samples shall be determined according to ASTM D4318.
- D. Testing agency will determine moisture content of fill material in accordance with ASTM D2216.
- E. Testing agency will test compaction of soils in place according to ASTM D1557, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 5000 sq. ft. or less of paved area, but in no case fewer than four tests per layer for each lift.
 - 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than three tests.
- F. Testing agency will determine compressive strength of cement-treated base course in accordance with LADOTD TR-432.

- G. 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 materials to depth required; recompact and retest until specified compaction is obtained.
- H. Testing agency will provide all test results to Engineer within forty-eight (48) hours of conducting each respective testing procedure.

3.16 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 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.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Where directed, transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Engineer.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312010

SECTION 312100 – EARTH MOVING AT 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 and Testing, LLC., dated May 19, 2022. 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. Excavating and backfilling for utility trenches.
 - 5. 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 31 Section "Concrete Drilled Piers and Shafts" for excavation of shafts and disposal of surplus excavated material.
 - 3. 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.

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- 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.

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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. Interruption 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 shall 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 10 and 22, and plot above the "A" line on the Plasticity Chart. 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 -1 to +3 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 either option on list below 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 |

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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. When trees are removed, the entire root ball shall be excavated such that the remaining roots measure 1/2 inch in diameter, or less.
 - 2. Strip 8 inches of topsoil minimum at building pad and within 10 feet of the building. Additional stripping may be required in some areas. The actual removal depth shall be determined in the field by the Testing Agency.
- 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 31 Section "Site Clearing."
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.
- E. If unstable subgrade is encountered after initial topsoil stripping, the Architect or Testing Agency may require the grading contractor to perform processing and drying of the upper maximum 12 inches of native subgrade by frequent windrowing with a dozer or plowing with a set of heavy duty disc harrows for at least three consecutive working days to achieve stable conditions for fill placement before consideration other mitigation approaches. The windrowing and drying effort shall be performed during a period with at least three consecutive days forecasted to be dry. The processed areas shall be sealed with the dozer at the end of the day in case of unanticipated overnight rain. The subgrade drying effort described above shall be included in the base bid.
- F. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated materials as directed by Architect.
- G. 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.
- H. Once existing soil is removed to required subgrade elevation, the moisture content of the upper two feet of existing subgrade shall be tested by the Testing Agency and evaluated by the Geotechnical Engineer to determine if moisture conditioning is required.
- I. See Section 3.7 below for required proofroll of existing subgrade to be performed immediately after preparation work noted above is complete and concurrently with moisture content testing.

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.

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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.
- C. Excavations shall not have deleterious effects on adjacent foundations or structures. Sequence construction as required to avoid deep excavations adjacent to foundations or structures, or when deep excavations adjacent to foundations or structures are unavoidable, provide temporary shoring as required in consultation with Geotechnical Engineer.

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 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.

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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.

3.7 SUBGRADE INSPECTION

- A. Notify Geotechnical Engineer when excavations have reached required subgrade.
- B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed. Moisture content testing shall be performed on upper two feet to determine if moisture conditioning is required.
- C. Proof-roll existing subgrade (after preparation as noted above has been completed) below the building slabs 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 20-25 ton, half-loaded tandem axle dump truck or similar heavy rubber-tired vehicle.
 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.
 - a. Prior to consideration of removal and replacement of existing soils, drying and processing of existing subgrade for three consecutive dry days shall be performed as described in Section 3.1 and existing subgrade shall be retested by proof-roll immediately after drying and processing period is complete.
- 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.

3.8 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.

3.9 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.

3.10 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.

3.11 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.

3.12 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 2 horizontal so fill material will bond with existing material. See variable fill placement diagram on Drawings.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under steps and ramps, use satisfactory soil material.
 - 2. Under building slabs (and within 10 feet of building slab edges), use satisfactory soil material.
 - 3. Under footings and foundations, use satisfactory soil material
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within -1 to +3 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.

3.14 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.
- 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).
- E. A sheep’s foot roller(s) shall be used to achieve compaction. The drum of the sheep’s foot roller shall be filled with water, or for additional weight, with both water and sand.

- F. A smooth wheel roller(s) shall be used to seal the working area at the end of the day's operations whenever rainfall is imminent.

3.15 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 95 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.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.16 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.

3.17 HOLD PERIOD

- A. Hold Period:
 - 1. To reduce long-term post construction total settlement to an acceptable level, a hold period shall be incorporated into the construction schedule to mitigate a portion of the fill induced settlement prior to building construction.
 - 2. All fill for the entire building pad, including ten feet beyond the perimeter of the building, shall be placed and held for a period of 45 days from the date the final lift of fill is placed at the planned building location.
 - 3. Installation of drilled shafts and other utilities can occur during the 45 day hold period, but construction of footings, grade beams, and floor slabs can not be performed until the hold period is complete.

4. The fill surface shall be proof-rolled at the immediately after hold period is complete to ensure no soft pockets have developed.

B. Settlement Monitoring Program:

1. A settlement monitoring program shall be incorporated into the construction program to provide data regarding on-going settlement to determine when the hold can be suspended, and building construction can commence.
2. For this program, at least six settlement plates (2-ft square steel plates with a 1-inch pipe extension) shall be placed across the building fill pad area in the areas with the largest amounts of fill and monitored (surveyed) prior to fill placement and once per week during the fill placement and for the perspective hold period to determine if sufficient settlement has occurred or that minimum settlement is ongoing.
3. Coordinate with Testing Agency and Geotechnical Engineer for proper implementation of settlement monitoring program. See Geotechnical Report for more information.

3.18 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. 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 building slab area, but in no case fewer than 3 tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 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 100 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.

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3.19 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.

3.20 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 312100

SECTION 316329 - DRILLED CONCRETE PIERS AND SHAFTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Specification Section 03 30 00 - Cast-in-Place Concrete shall be applicable to the concrete material used in drilled concrete piers. For drilled concrete piers, Section 31 63 29 shall supersede section 03 30 00 where specific items are addressed in both specification sections.

1.2 SUMMARY

- A. Section Includes:
 - 1. Dry-installed drilled piers.
 - 2. Slurry displacement-installed drilled piers.
- B. Related Sections:
 - 1. Division 31 Section "Earth Moving (Building Pad)" for preparation of subgrade for drilled-pier operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface.
- C. Terminology:
 - 1. The terms Pier, Shaft, Caisson, Drilled Pier, Drilled Shaft, and Drilled Caisson shall all be considered equivalent terms/elements and shall be covered by this specification and the associated contract drawings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Qualification Data: For qualified Installer testing agency.
- D. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Steel reinforcement and accessories.
- E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

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1. Aggregates.
 2. Field quality-control reports.
- F. Prepare test and inspection reports for each drilled pier as defined in Field Quality Control paragraph (Part 3) of this specification.
- 1.4 QUALITY ASSURANCE
- A. Installer Qualifications: An experienced installer that has specialized in drilled-pier work that has completed at least three (3) successful projects.
 - B. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.
 - C. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."
 - D. Drilled-Pier Standards: Comply with ACI 336.1 and FHWA-NHI-18-024/FHWA GEC 010, unless modified in this Section.
- 1.5 PROJECT CONDITIONS
- A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.
 1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.
 - B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 1. Notify Owner no fewer than three days in advance of proposed interruption of utility.
 2. Do not proceed with interruption of utility without Owner's written permission.
 - C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
 1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.
 2. The geotechnical report is referenced in the Division 31 Section "Earth Moving".
 - D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record

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actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Wire: ASTM A 82, as drawn.
- C. Deformed-Steel Wire: ASTM A 496.
- D. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain. Cut bars true to length with ends square and free of burrs.

2.2 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source, throughout Project:
 1. Portland Cement: ASTM C 150, Type I/II.
 - a. Fly Ash: Not allowed in any concrete in this project.
 - b. Slag: Not allowed in any concrete in this project.
- B. Normal-Weight Aggregate: ASTM C 33, graded, 3/4-inch- nominal maximum coarse-aggregate size. Provide aggregate from a single source.
 1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.
- D. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 3. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
- E. Sand-Cement Grout: Portland cement, ASTM C 150, Type II; clean natural sand, ASTM C 404; and water to result in grout with a minimum 28-day compressive strength of 1000 psi, of consistency required for application.

2.3 STEEL CASINGS (IF REQUIRED)

- A. Temporary casing may be required due to conditions encountered at the site at the time of construction.

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- B. Steel Pipe Casings: ASTM A 283/A 283M, Grade C, or ASTM A 36/A 36M, carbon-steel plate, with joints full-penetration welded according to AWS D1.1/D1.1M.

2.4 SLURRY (IF REQUIRED)

- A. Slurry: Pulverized bentonite or polymers mixed with water to form stable colloidal suspension; complying with ACI 336.1 for density, viscosity, sand content, and pH.
- B. Contractor shall include slurry in price and credit owner the difference if slurry is not required.

2.5 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Proportion normal-weight concrete mixture as indicated in the drawings:

2.6 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

- A. Inspector from testing agency must be on site during excavation and concreting of all shafts. It is the Contractor's responsibility to notify the testing agency at least 48 hours in advance of any excavation work being performed.
- B. Perform test holes as noted on Drawings to assess drilling conditions and determine whether slurry or casing is required for shaft installation.

- C. The Engineer must be on site for the excavation and concreting of the first three shafts to be excavated on the project. It is the Contractor's responsibility to notify the engineer at least 48 hours in advance of any excavation work being performed.
 - D. Classified Excavation: Excavation is classified as standard excavation, special excavation, and obstruction removal and includes excavation to bearing elevations as follows:
 - 1. Standard excavation includes excavation accomplished with conventional augers fitted with soil or rock teeth or drilling buckets attached to drilling equipment of size, power, torque, and downthrust necessary for the Work.
 - E. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.
 - F. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
 - 1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
 - 2. Remove water from excavated shafts before concreting.
 - 3. Do not excavate shafts deeper than elevations indicated unless approved by Architect.
 - 4. Payment for additional authorized excavation will be according to Contract provisions for changes in the Work.
 - G. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set for 24 hours. This applies to all drilled piers with a clear spacing of 72 inches or less.
 - H. Slurry Displacement Method: Stabilize excavation with slurry maintained a minimum of 60 inches above ground-water level and above unstable soil strata to prevent caving or sloughing of shaft. Maintain slurry properties before concreting.
 - 1. Excavate and complete concreting of drilled pier on same day. If absolutely not possible, redrill, clean, and test slurry in excavation before concreting.
 - I. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
 - 1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.
 - J. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.
 - 1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Architect for review before proceeding.
- 3.3 STEEL REINFORCEMENT
- A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

- C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.
- D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover over reinforcement.
- E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.
- F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.
- G. The steel reinforcing cage, consisting of longitudinal and transverse bars, ties, and cage stiffener bars, shall be completely assembled and placed as a unit immediately after the shaft excavation is inspected and accepted, and prior to concrete placement. The reinforcing cage may be rigidly braced to retain its configuration during handling and construction.
 - 1. For shafts reinforced with a single longitudinal bar only, the reinforcement bar may be placed immediately after placement of concrete.

3.4 CONCRETE PLACEMENT

- A. See notes in Excavation regarding inspector being present during concreting and Engineer being on-site for concreting of first three shafts installed.
- B. Concrete must be placed within 30 minutes after excavation is drilled for each drilled pier.
- C. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.
 - 1. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.
- D. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement using tremie methods.
 - 1. Free-fall concrete placement is not allowed.
 - 2. Vibrate top 60 inches of concrete.
- E. Slurry Displacement Method: Place concrete in slurry-filled shafts by tremie methods or pumping. Control placement operations to ensure that tremie or pump pipe is embedded no fewer than 60 inches into concrete and that flow of concrete is continuous from bottom to top of drilled pier.
 - 1. Shafts filled by use of slurry-displacement method shall be poured at least 12 inches above the necessary top elevation to ensure that all slurry has been displaced with uncontaminated concrete.
 - 2. After this required over-pour has been done, excess concrete may be removed without disturbing reinforcing steel.
- F. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.
 - 1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.

- G. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.
- H. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.
 - 1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.
- I. If hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 deg F.
 - 1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of seven days.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner shall engage a qualified special inspector to perform the following special inspections:
 - 1. Drilled piers.
 - 2. Excavation.
 - 3. Concrete.
- B. Testing Agency: Owner shall engage a qualified testing agency to perform tests and inspections.
- C. Concrete Tests and Inspections: ASTM C 172 except modified for slump to comply with ASTM C 94/C 94M.
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 3 cu. yd., but less than 9 cu. yd., plus one set for each additional 27 cu. yd. or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C 143/C 143M; one test at point of discharge for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 - 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports for each drilled pier as follows:
1. Concrete testing results.
 2. A numbered plan including all shafts.
 - a. Note shafts where concrete samples were taken.
 3. Actual excavated length and diameter of each shaft drilled.
 4. Note if any shaft irregularities have been observed.
 5. Note any problems with sloughing or collapsing of shaft walls.
 6. The approximate maximum height of free water inside of the excavated shaft prior to concreting of shaft.
 7. Note if water remained in shaft at commencement of concreting and provided estimated amount. Note if water was pumped from shaft excavation.
 8. Verification of proper reinforcement placement.
 9. Note any problems during excavating or concreting of shaft.
 10. Remarks, unusual conditions encountered, and deviations from requirements.

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3.6 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 Owner's property.

END OF SECTION 316329

SECTION 321313 - CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes exterior concrete paving for the following items:
 - 1. Driveways.
 - 2. Parking lots.
 - 3. Sidewalks.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Provide material certifications for items to be provided in accordance with LADOTD QPL.

1.3 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 STEEL REINFORCEMENT

- A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064, fabricated from as-drawn steel wire into flat sheets.
- B. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
- C. Reinforcing Bars: ASTM A615, Grade 60; deformed.
- D. Joint Dowel Bars: ASTM A615, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

2.3 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C150, Type I or Type II.
 - 2. Fly Ash: ASTM C618, Class F.
 - a. Product shall be restricted to suppliers and sources provided on LA DOTD QPL 50.
- B. Aggregates: ASTM C33, uniformly graded. Provide aggregates from a single source.
 - 1. Maximum aggregate size: No greater than 1/4 of the depth of each respective slab thickness.
- C. Air-Entraining Admixture: ASTM C260.
- D. Chemical Admixtures: ASTM C494. Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
- E. Water: Potable and complying with ASTM C94.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.5 RELATED MATERIALS

- A. Joint Fillers (vehicular pavement only):
 - 1. Clear heart redwood in accordance with LADOD Standard Specification section 1005.01.2.
- B. Cold-Applied Joint Sealants:
 - 1. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, non-sag silicone sealant complying with ASTM D5893 for Type NS.
 - a. Product shall be restricted to suppliers and sources provided on LA DOTD QPL 42.
 - 2. Type SL Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D5893 for Type SL.
 - a. Product shall be restricted to suppliers and sources provided on LA DOTD QPL 42.
- C. Joint-Sealant Backer Materials:
 - 1. Round Backer Rods for Cold-Applied Sealants: ASTM D5249, Type 3, of diameter and density require to control sealant depths and prevent bottom-side adhesion of sealant.
- D. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.6 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type, strength, and thickness of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
 - 1. Fly Ash or Pozzolan: 20 percent.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: 4.5 percent plus or minus 1-1/2 percent.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete as required for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- E. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days):
 - a. Pavement and barrier curbs: 4000 psi.
 - b. Sidewalks: 3000psi.
 - 2. Maximum W/C Ratio at Point of Placement: 0.45.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.
 - a. Modification to slump limit is permitted with the use of water-reducing admixtures.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Proof-roll prepared subbase surface below areas of proposed concrete pavements in accordance with Specification Section 312010, "Earth Moving (Site)" to identify soft pockets and areas of excess yielding.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

- A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Construction joints shall be permitted to replace contraction joints in pavement areas. All other joints shall be constructed as indicated.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- D. Screed paving surface with a straightedge and strike off.
- E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these methods.

3.9 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 1/4 inch.
 - a. Maximum variations in surface tolerance shall not exceed 1/4 inch in 10 feet.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Joint Spacing: 3 inches.
 - 4. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 5. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C31; cast and laboratory cure one set of four standard cylinder specimens for each composite sample. One specimen shall be retained for later testing, if required.
 6. Compressive-Strength Tests: ASTM C39; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no individual compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
 1. Concrete paving that has been determined to be defective shall be replaced at no additional cost to the Owner.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.11 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321723 - PAVEMENT MARKINGS

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 painted markings applied to concrete pavement.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for alkyd materials, 55 deg F for water-based materials], and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", the ABA standards of the Federal agency having jurisdiction, and ICC A117.1.

2.2 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type S; colors complying with FS TT-P-1952.
 - 1. Color: As indicated on drawings.
- B. Glass Beads: AASHTO M 247, Type 1.
 - 1. Roundness: Minimum 75 percent true spheres by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for a minimum of 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
 - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
 - 2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal.

3.3 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

SECTION 331416 – SITE WATER DISTRIBUTION

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 water-distribution piping and related components outside the building for water service mains.
- B. All fees assessed by Water Company for tap, service extension, and meters shall be included in the original contract sum.

1.3 DEFINITIONS

- A. PVC: Polyvinyl Chloride
- B. DI: Ductile Iron

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
- C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. 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.
- D. Comply with ASTM F645 for selection, design, and installation of thermoplastic water piping.
- E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
 - 1. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution 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 water-distribution service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.8 COORDINATION

- A. Coordinate connection to water main with utility company.
 - 1. Water Company will provide tap from existing water main, service extension, and water meters.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.2 PVC PIPE AND FITTINGS

- A. Domestic Service: PVC, Schedule 40 Pipe: ASTM D1785.
 - 1. PVC, Schedule 40 Socket Fittings: ASTM D2466.
- B. Domestic Service: IPS PVC Pressure Pipe: ASTM D2241
- C. Fire Service: PVC, AWWA Pipe: AWWA C900, Pressure Class 165, with bell end with gasket, and with spigot end.
 - 1. Comply with UL 1285 for fire-service mains if indicated.
 - 2. PVC Fabricated Fittings: AWWA C900, Pressure Class 165, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 3. PVC Molded Fittings: AWWA C907, Pressure Class 165, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.
 - 5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.3 JOINING MATERIALS

- A. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.4 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
 - 1. OS&Y, Non-Rising-Stem, Metal-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.
 - 1) Standard: AWWA C500.
 - 2) Minimum Pressure Rating: 200 psig.
 - 3) End Connections: Flanged.
 - 2. OS&Y, Non-Rising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig.
 - 3) End Connections: Flanged.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
 - 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.6 CHECK VALVES

- A. AWWA Check Valves:
 - 1. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
 - a. Standard: AWWA C508.
 - b. Pressure Rating: 200 psig.

2.7 WATER METERS

- A. Water meters will be furnished by Water Company.

2.8 BACKFLOW PREVENTERS

- A. Backflow preventer shall be located immediately downstream of water meter and shall have thermal protection as listed in this section.
- B. Double-Check Backflow Prevention Assemblies:
 - 1. Standard: ASSE 1015 or AWWA C510.
 - 2. Operation: Continuous-pressure applications.
 - 3. Size: Shall match service main size indicated on Drawings.
 - 4. Pressure Loss at Design Flow Rate: Coordinate with plumbing engineer for requirements.
 - 5. Body: Bronze for NPS 2 and smaller; cast iron or steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 - 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - 7. Configuration: Designed for horizontal, straight through flow.
 - 8. Accessories:
 - a. Valves: Ball valves with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

2.9 PROTECTIVE ENCLOSURES

- A. Freeze-Protection Enclosures:
 - 1. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of 40 deg F when external temperatures reach as low as 0 deg F.
 - a. Standard: ASSE 1060.
 - b. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
 - c. Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
 - 1) Housing: Reinforced aluminum construction.

- a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - b) Drain opening for units with drain connection.
 - c) Access doors with locking devices.
 - d) Insulation inside housing.
 - e) Anchoring devices for attaching housing to concrete base.
- 2) Electric heating cable or heater with self-limiting temperature control.
- B. Enclosure Bases:
1. Description: 4-inch minimum thickness precast concrete, of dimensions required to extend at least 6 inches beyond edges of enclosure housings. Include openings for piping.
 - a. Comply with enclosure manufacturer's requirements for concrete compressive strength and reinforcement.

2.10 FIRE HYDRANTS

A. Wet-Barrel Fire Hydrants:

1. Description: Freestanding, with two NPS 5-1/4 outlets, NPS 8 threaded or flanged inlet, and base section with NPS 8 mechanical-joint inlet. Include interior coating according to AWWA C550.
 - a. Standard: AWWA C503.
 - b. Pressure Rating: 150 psig minimum.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Section 312010 "Earth Moving (Site)" for excavating, trenching, and backfilling.

3.2 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, metal-seated gate valves with valve box.
 2. Use the following for valves in vaults and aboveground:
 - a. Gate Valves, NPS 2 (DN 50) and Smaller: Bronze, rising stem.
 - b. Gate Valves, NPS 3 (DN 80) and Larger: AWWA, cast iron, OS&Y rising stem, metal seated.
 - c. Check Valves: AWWA C508, swing type.
 3. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.
 4. Relief Valves: Use for water-service piping in vaults and aboveground.
 - a. Air-Release Valves: To release accumulated air.
 - b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.
 - c. Combination Air Valves: To release or admit air.

3.3 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- B. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- C. Bury piping with depth of cover over top at least 36 inches, with top at least 12 inches below level of maximum frost penetration.
- D. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- E. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- F. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.4 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 - 1. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
 - 2. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - a. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
 - b. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

3.5 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Concrete thrust blocks.
 - 2. Locking mechanical joints.
 - 3. Set-screw mechanical retainer glands.
 - 4. Bolted flanged joints.
 - 5. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.6 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves. Install full-size valved bypass.
- H. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.7 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.

3.8 PROTECTIVE ENCLOSURE INSTALLATION

- A. Install concrete base level and with top approximately 2 inches above grade.
- B. Install protective enclosure over valves and equipment.
- C. Anchor protective enclosure to concrete base.

3.9 CONNECTIONS

- A. Connect water-distribution piping to utility water main extension.
- B. Connect water-distribution piping to interior domestic water piping.

3.10 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Backflow preventers shall be tested in accordance with International Plumbing Code Section 312.10 and all referenced standards.

- D. Prepare reports of testing activities.

3.11 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 31 20 10 "Earth Moving (Site)".
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel.

3.12 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 331416

SECTION 333113 - SITE SANITARY SEWER

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. PVC pipe and fittings.
 - 2. Expansion joints and deflection fittings.
 - 3. Cleanouts.
 - 4. Manholes.
 - 5. Concrete.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe and fittings.
 - 2. Non-pressure couplings
 - 3. Expansion joints and deflection fittings.
 - 4. Cleanouts.
- B. Field quality-control reports.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Sewerage 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 service.
 - 2. Do not proceed with interruption of service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. Gravity Piping: PVC Type PSM Sewer Piping, Cell Class 12454
 - 1. Pipe: ASTM D 3034, SDR 26, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: ASTM D 3034, PVC with bell ends.
 - 3. Gaskets: ASTM F 477, elastomeric seals.

2.2 EXPANSION JOINTS AND DEFLECTION FITTINGS

- A. Ductile-Iron, Flexible Expansion Joints:
 - 1. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110/A21.10 or AWWA C153/A21.53. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.
- B. Ductile-Iron Expansion Joints:
 - 1. Description: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110/A21.10 or AWWA C153/A21.53. Include rating for 250-psig minimum working pressure and for expansion indicated.
- C. Ductile-Iron Deflection Fittings:
 - 1. Description: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110/A21.10 or AWWA C153/A21.53. Include rating for 250-psig minimum working pressure and for up to 15 degrees of deflection.

2.3 CLEANOUTS

- A. Cast-Iron Cleanouts:
 - 1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
 - 2. Top-Loading Classification(s): Medium Duty and Extra-Heavy Duty.
 - 3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.
- B. PVC Cleanouts:
 - 1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.4 MANHOLES

- A. Standard Precast Concrete Manholes:
 - 1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 2. Diameter: 48 inches minimum unless otherwise indicated.
 - 3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 - 4. Base Section: 6-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
 - 5. Riser Sections: 5-inch minimum thickness, of length to provide depth indicated.
 - 6. Top Section: Concentric-cone type with top of cone of size that matches grade rings.

7. Joint Sealant: ASTM C990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: Do not provide.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

2.5 CONCRETE

- A. General: Cast-in-place concrete complying with ACI 318 and the following:
 1. Cement: ASTM C150, Type II.
 2. Fine Aggregate: ASTM C33, sand.
 3. Coarse Aggregate: ASTM C33, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
 1. Reinforcing Fabric: ASTM A1064, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A615, deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 1 percent through manhole.
 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 8 percent.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
 1. Reinforcing Fabric: ASTM A1064, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A615, Grade 60 deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312010 "Earth Moving (Site)".

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install cleanouts at changes in direction. Use fittings for branch connections unless direct tap into existing sewer is indicated.

- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
 - 2. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 3. Install ductile-iron, gravity sewer piping according to ASTM A746.
- G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Join PVC Type PSM sewer piping according to ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasket joints.
 - 2. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Unshielded flexible couplings for pipes of same or slightly different OD.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Medium-Duty, top-loading classification cleanouts in unpaved areas.
 - 2. Use Extra-Heavy-Duty, top-loading classification cleanouts in all paved areas.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 22 13 00 "Sanitary Waste and Vent Storm Drainage".

3.6 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate report for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Re-inspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.
 - e. Test and inspect joints for leaks.
 - 6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Test plastic gravity sewer piping according to ASTM F 1417.
 - 7. Manholes: Perform hydraulic test according to ASTM C969.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.7 CLEANING

- A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION 333113

SECTION 334200 – SITE STORM DRAINAGE

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.
- B. All references to LADOTD specifications are to the Louisiana Standard Specifications for Roads and Bridges, 2016 Edition.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Cleanouts.
 - 3. Stormwater inlets and manholes.

1.3 SUBMITTALS

- A. Product Data: For drainage structures, pipes, and fittings.
- B. Shop Drawings:
 - 1. All drainage structures shall be identified by the designations provided on the construction drawings.
 - 2. Manholes: Include plans, top and invert elevations, pipe elevations, sections, details, reinforcement, frames, and covers.
 - 3. Stormwater inlets: Include plans, top and invert elevations, pipe elevations, sections, details, reinforcement, frames, and grates.
 - 4. Subsurface stormwater detention systems: Include plans, top and invert elevations, pipe connection locations and elevations, inlet locations and elevations, sections, and details.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

- C. Handle manholes in accordance with manufacturer's written rigging instructions.
- D. Handle stormwater inlets in accordance with manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 PLASTIC PIPE AND FITTINGS

- A. PVC Gravity Sewer Piping:
 - 1. Pipe and Fittings: ASTM F 949, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.
- B. HIGH-DENSITY POLYETHYLENE (HDPE) GRAVITY PIPE AND FITTINGS
 - 1. Pipe and Fittings: Pipe and Fittings: ASTM F 2306, HDPE gravity-flow storm sewer pipe with integral bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.
- C. POLYPROPYLENE (PP) GRAVITY PIPE AND FITTINGS
 - 1. Pipe and Fittings: ASTM F 2881, HDPE gravity-flow storm sewer pipe with integral bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

2.2 CONCRETE PIPE AND FITTINGS

- A. Reinforced-Concrete Pipe and Fittings
 - 1. Provide in accordance with LADOTD specification Section 701 and all referenced sections.

2.3 CLEANOUTS

- A. Cast-Iron Cleanouts:
 - 1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside caulk or spigot connection and countersunk, tapered-thread, brass closure plug.
 - 2. Top-Loading Classification(s): Medium and Extra-Heavy Duty
 - 3. Pipe Fitting and Riser to Cleanout: PVC Schedule 80 or SDR 35 plastic pipe and fittings.

2.4 PRE-CAST CONCRETE DRAINAGE STRUCTURES

- A. Provide structures in accordance with plans, conforming to dimensions, reinforcement, and appurtenances as indicated.
- B. Standard Precast Concrete Drainage Structures:
 - 1. Description: ASTM C 913, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
 - 3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 - 4. Resilient Pipe Connectors: ASTM C 923, cast or fitted into structure walls, for each pipe connection.
- C. Manhole Frames and Covers:
 - 1. Description: Ferrous; 24-inch inside diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
 - 2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

- D. Stormwater Inlet Frames and Grates: Include flat grate with short-slotted drainage openings.
 - 1. Size: as indicated on Drawings.
 - 2. Grate Free Area: Approximately 50 percent unless otherwise indicated.
 - a. Provide grate with ADA-compliant openings where required.
 - 3. Material: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16 (AASHTO HS20-44), structural loading.

2.5 POLYMER STORMWATER STRUCTURES

- A. Provide structures in accordance with plans, conforming to dimensions, materials, and appurtenances as indicated.
- B. Polymer Drainage Structures:
 - 1. Description: ASTM D1784, Polyvinyl Chloride, of depth indicated, with provision for sealant joints.
 - 2. Joint Sealant: ASTM F477
 - 3. Pipe Connections: ASTM D3212, fitted into connection stubs provided on basin channel.
 - 4. Bedding Material: ASTM D2321, placed to dimensions required by manufacturer and uniformly compacted.
- C. Frames and Grates for Inlets: Provide square frame and grate fitted onto circular basin channel.
 - 1. Size: As indicated on drawings.
 - 2. Grate Free Area: Approximately 50 percent unless otherwise indicated.
 - 3. Material: ASTM A536, Grade 70-50-05, ductile iron designed for AASHTO H10-44 or HS20-44 structural loading.

2.6 CONCRETE

- A. General: Cast-in-place concrete in accordance with ACI 318, ACI 350, and the following:
 - 1. Cement: ASTM C 150/C 150M, Type II.
 - 2. Fine Aggregate: ASTM C 33/C 33M, sand.
 - 3. Coarse Aggregate: ASTM C 33/C 33M, crushed gravel.
 - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
 - 1. Reinforcing Fabric: ASTM A 1064/A 1064M, steel, welded wire fabric, plain.
 - 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Section 312010 "Earth Moving (Site)".

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Stormwater runoff shall not be directed towards or allowed to shed into open pipe trenches.
- G. Adequate ground cover, as determined by manufacturer, shall be provided over installed pipe to prevent flotation. If adequate depth cannot be achieved, anchor system per manufacturer's recommendation shall be provided at no additional cost to Owner.
- H. Install gravity-flow, nonpressure drainage piping in accordance with the following:
 1. Install piping pitched down in direction of flow.
 2. Install PVC sewer piping in accordance with ASTM D 2321 and ASTM F 1668.
 3. Install reinforced-concrete sewer piping in accordance with ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping in accordance with the following:
 1. Join PVC corrugated sewer piping in accordance with ASTM D 2321 for elastomeric-seal joints.
 2. Join PVC sewer piping in accordance with ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
 3. Join perforated PVC sewer pipe and fittings according to ASTM D3212 with loose bell-and-spigot, push-on joints.
 4. Join reinforced-concrete sewer piping in accordance with ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
 5. Join dissimilar pipe materials with nonpressure-type flexible couplings.
- B. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use plastic pipe fittings in sewer pipes at branches for cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 1. Use Medium Duty top-loading classification cleanouts in areas of grass, landscaping, or that will be subject to foot traffic only.
 2. Use Extra-Heavy Duty top-loading classification cleanouts in areas of proposed vehicular use.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

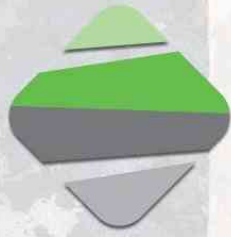
3.5 DRAINAGE STRUCTURE INSTALLATION

- A. General: Install manholes and inlets, complete with appurtenances and accessories indicated.
- B. Install precast drainage structure sections with sealants in accordance with ASTM C 891.
- C. Where specific drainage structure construction is not indicated, follow manhole manufacturer's written instructions.
- D. Precast Concrete Manholes:
 - 1. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.
- E. Precast Concrete Inlets:
 - 1. Construct catch basins to sizes and shapes indicated.
 - 2. Set frames and grates to elevations indicated.

3.6 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems in accordance with requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Gravity-Flow Storm Drainage Piping: Test in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping in accordance with ASTM F 1417.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
- E. Maintain stormwater pollution prevention measures at each drainage structure and conveyance system throughout project duration. Clean interior of piping and drainage structures of dirt and superfluous materials (do not flush into outfall system).

END OF SECTION 334200



Premier
GEOTECH
AND TESTING, LLC

Subsurface Exploration and Geotechnical Engineering Report

Proposed The Newtron Group – New Campus Project
Baton Rouge, Louisiana
Premier File No.: 21-0020_Final

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INTRODUCTION

Premier Geotech and Testing, LLC (Premier) is pleased to present this Subsurface Exploration and Geotechnical Engineering Report for the proposed The Newtron Group – New Campus project. Our services were performed in general accordance with the agreement between Premier and WTD Architecture, authorized by W. Tommy Dauzat on February 5, 2021.

PROJECT AND SITE DESCRIPTION

We understand that the proposed project will consist of design and construction of a new 2-story building with an approximate plan area of 62,200 square feet and its associated parking and drive areas. The proposed finish floor elevation for the building is twenty-eight (28) feet. Therefore, up to five (5) feet of fill will be required to achieve design grade. The project will also include a future development of a warehouse building, an integration building, a lay down area, and additional parking. This future development will be located at the rear end of the site. In addition, two (2) stormwater detention areas will be located to the east and south of the building. Reportedly, the 2-story structure will primarily consist of a concrete-filled corrugated metal floor deck over open web steel joists, supported by wide flange steel beams and steel tube columns. The warehouse buildings will be pre-engineered metal building structures. The proposed project site is located along Airline Highway, approximately ½-mile northwest of the intersection with Barringer Foreman Road in Baton Rouge, Louisiana.

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 | R ¹ | B ² |
|--|------------------------------|-------------------------------------|-------------------------------------|
| 3-STORY BUILDING | | | |
| Maximum Column Load | 160 kips downward (D + L) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Maximum Sustained Column Load | 100 kips (Dead) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Maximum Column Net Uplift | 100 kips (0.6Dead + 0.6Wind) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Maximum Wall Loads | 2000 lbs/ft (Dead) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Settlement Tolerances | Less than one (1) inch | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| GRADING | | | |
| Anticipated Amount of Fill Material Required to Achieve Design Grade | Up to five (5) feet | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

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 medium stiff to very stiff alternating layers of lean and fat clays in the upper eight (8) feet over stiff to very stiff fat clays to a depth of about sixty-five (65) feet, the maximum depth explored.

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.

Groundwater Conditions

Free groundwater was encountered at a depth of about four (4) feet below existing grade in boring B-5 and at a depth of about thirty (30) feet below grade in boring B-1 at the time of our field exploration. 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.

Seismic Classification

As requested, we classified the site in accordance with the 2018 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.

Presence of Expansive Soils

Field and laboratory test results indicate that the soils encountered at the site, within the main building area, exhibit moderate shrink and swell potential. A swell test, following the procedures

on ASTM D4546, was performed with an applied contact pressure of 100 psf. The measured swell potential was about 0.75 inches. Therefore, and based on the subsurface materials encountered within the main building area, mitigation of the site conditions will not be necessary to maintain the potential vertical movement to less than one (1) inch.

However, note that the subsurface soils encountered to the back of the property (area of future development) has a high potential for vertical rise. **Potential Vertical Rise (PVR) values higher than one (1) inch were calculated using the TEX-124E method with an applied contact pressure of 100 psf and assuming an active zone of ten (10) feet.** Therefore, we recommend Premier perform a swell test with the subsoils of that area in order to verify the potential for vertical rise.

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 and D-2 were drilled and sampled within the footprint of the originally proposed stormwater detention area. However, the layout of the project changed, and boring B-3 is the one that lays within the proposed Pond #1 footprint. The subsurface soils encountered in this boring generally consist of intermittent layers of fat and lean clays to the boring's completion depth at about thirty (30) feet.

Based on the laboratory test data, the lean clay materials encountered from a depth of about two (2) to eight (8) feet in boring B-3 had Liquid Limits (LL) and Plasticity Indices (PI) that are typically acceptable to be used as structural fill material. The fat clay materials encountered do not comply with the LL and PI specifications for structural fill. However, we anticipate that if the fat clay materials are blended with the lean clays, the soil mixture may comply with the LL and PI specifications for structural fill. We recommend Premier test the blended material prior to its use to confirm it complies with the structural fill specifications as indicated on this report. Otherwise, lime treatment of these materials may alter their soil properties to meet structural fill requirements. The exact percentage of lime is not known at this time; however, Premier can perform a lime series to determine the best percentage if requested.

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 and the laboratory test results, the encountered subsoil materials indicated moderate (north part of the site, where main building will be located) to high (south of the property, proposed area for future development) shrink-swell potential and moderate to high compressibility. The moderate to high compressibility of the in-situ soils will produce settlement of the subgrade in excess to one (1) inch once foundation and fill loads are introduced. Therefore, we recommend implementing a fill hold program in order to accelerate the consolidation of the in-situ soils until the anticipated post-construction settlement is less than one (1) inch. The fill hold program consists of placing the required fill to achieve design grade and waiting for a period of time (discussed in the section below) prior to construction of the structures. The fill hold program will allow the subsurface soils to consolidate and result in a total settlement of less than one (1) inch after construction of the structures.

After successful completion of the fill hold program, the main building can be supported on a combination of deep foundations under the columns and shallow continuous spread footings under the load bearing walls. Recommendations for both types of foundations are presented in the sections below.

The provided topography plans indicated that the main, two-story building will be placed on uneven amounts of fill. Therefore, to reduce the magnitude of differential settlement within different amount of fill areas, we recommend placing the fill in benches or terraces as discussed below and as illustrated in the sketch included in the Appendix at the end of this report.

The proposed future development (warehouse building and integration building) can be supported on a shallow foundation system provided that no more than one (1) foot of fill material is required to achieve design grade. If more than one (1) foot of fill is required, they should be supported a deep foundation system. Furthermore, due to the high shrink-swell potential of the subsurface soils at this area of the site, a post-tensioned slab BRAB Type III or a pile supported slab is recommended. **Once final design plans are available for the future development, Premier can review them and revise/adjust the foundation recommendations presented in this report, if necessary. Post-tensioned slab recommendations will be provided, if necessary, once the final plans are reviewed by Premier.**

Please note that the upper two (2) feet of subsurface soils across the north part of the site were dry at the time of our field exploration. Therefore, moisture conditioning may be required to reduce the shrink/swell potential and pass a proof-roll. We recommend a representative of Premier evaluate the in-situ soils moisture at the time of construction.

Fill Hold Program

Time-Rate-Settlement Analysis

The recommended fill hold program for this project involves the placement of the fill material required to achieve design grade elevation and leave it on hold for a period of time such that the majority of anticipated settlement occur prior to foundation construction. In addition, monitoring of

the fill hold program using settlement plates and other instrumentation shall be performed to determine the effectiveness of the program.

The estimated total settlement from placement of up to five (5) feet of fill material at the project site is presented on the table below. After the fill material has been in-place for a period of 45 days, construction of the foundation footings can begin and it is estimated that the total settlement will be less than one (1) inch. The proposed fill material should be placed using the benching method as previously discuss. After successful completion of the fill hold program, removal of vegetation, re-grading, and compaction of the near surface soil will be required, if deemed necessary, to achieve the floor slabs finished subgrade.

| Time Rate Settlement Analysis | | | | |
|--------------------------------------|--|--|----------------|----------------|
| Fill Height (ft) | Total Estimated Settlement (in) | Anticipated Amount of Settlement Achieved after Fill Placement (in) | | |
| | | 15 Days | 30 Days | 45 Days |
| 1 | 0.46 | 0.35 | 0.46 | - |
| 2 | 0.8 | 0.59 | 0.8 | - |
| 3 | 1.09 | 0.73 | 0.75 | - |
| 4 | 1.35 | 0.55 | 0.89 | - |
| 5 | 1.58 | 0.55 | 0.89 | 1.04 |

Consolidation tests were not performed for this project. However, based on our experience with similar soils conditions, a coefficient of consolidation (Cv) value of 0.01 ft²/day was used for our analyses. Please note that deeper soils will contribute to the settlement if fill height or area is increased. Furthermore, these time estimates are based on a conservative assumption of one-way drainage per our understanding of depth of influence for settlement and existing subsurface conditions.

Field Monitoring Recommendations

Settlement plates should be placed at the natural subgrade prior to placing any fill. Premier recommends installing at least two (2) plates in areas with the highest amount of fill. Settlement plates should consist of two (2) foot square steel plates a minimum of 3/8 inch thick. The plates should be firmly seated at the natural ground surface and rigidly connected to one (1) inch diameter or larger threaded steel pipe, in five (5) foot sections (this can be achieved by welding a coupling to the plate and then screwing the threaded pipe into it. Similarly, another coupling shall be screwed at the top of the pipe, if a five (5) feet section has to be added on top). The top of the steel pipe should extend approximately 24 inches above the finished surcharge fill grade. Prior to placing any fill, a zero reading of each settlement plate must be obtained by referencing a benchmark located a sufficient distance to not be influenced by the filling operations. During the fill

placement, a three (3) inch diameter or larger PVC pipe should be installed approximately six (6) inches above the plate, as a friction sleeve around the steel pipe.

Readings should be taken on a weekly basis during and after completion of fill placement until the anticipated settlement has been completed or the settlement rate has stabilized.

Care should be taken during fill placement to not disturb or damage the settlement plate extension pipes. For this purpose, Premier suggests extending the PVC pipe at least 12 inches above the top of settlement plate extension pipes and paint with bright color for better visibility. After the rate of settlement has been stabilized, the settlement plate extension pipes should be removed. In addition, Premier suggests that the structural fill surface shall be proof rolled prior actual construction activity to ensure no soft pockets have developed.

Structural Fill Construction Recommendations

Prior to fill construction and upon completion of the stripping activities, the exposed areas must be properly proof rolled. The proof roll activities should be performed using a 20- to 25-ton loaded dump truck. Surface soils that are observed to rut or deflect excessively (greater than one (1) inch) under the truck load should be undercut and replaced with the properly compacted structural fill. These activities should be performed during a period of dry weather and be supervised by Premier's Geotechnical Engineer or his representative. The fill material should meet the requirements for structural fill material as described in this report.

After all surface preparation and observation has been completed, fill placement in benches or terraces may begin. The benches or terraces should be a minimum of 12 feet wide laterally and should be cut into the slope every two (2) feet of vertical rise. The first layer of fill should be placed in a relatively uniform horizontal lift on the prepared subgrade soils. Structural fill material should be free of organic or other deleterious materials, have a maximum clay lump size less than six (6) inches and have a liquid limit of less than forty (40) with plasticity index (PI) values between ten (10) and twenty-two (22) and plot above the "A" line on the Plasticity Chart.

Structural fill should be placed in maximum lifts of eight (8) inches of loose materials and should be compacted within the range of one (1) percentage point below to three (3) percentage points above the optimum moisture content value as determined by the Standard Proctor test.

Structural fill should be compacted to at least 95 percent of the Standard Proctor maximum dry density as determined by ASTM Designation D 698.

A sheep's foot roller(s) must be used to achieve compaction. The drum of the sheep's foot roller shall be filled with water, or for additional weight, with both water and sand. Tractors or other vehicles used primarily for hauling WILL NOT be allowed as fill compaction equipment. The contractor should also have a smooth wheel roller(s) to seal the working area at the end of the day's operations, so the overnight rains will not saturate the soil and delay his work. The smooth wheel rollers should be used to seal the surface whenever rainfall is imminent. Premier's

representative will instruct the contractor to modify or remove from the site any equipment that in his/her opinion is not capable of compacting the fill to the required density.

Each lift of compacted soil shall be tested and inspected by a representative of Premier prior to placement of subsequent lifts. No material shall be placed on any lifts that has not been accepted by a representative of Premier. It is recommended that field density tests be performed at a frequency of not less than one test per 2,500 square feet/lift.

Fill slopes shall be maintained at a maximum 2 Horizontal: 1 Vertical steepness. The runoff of water across the faces of the slopes shall be avoided by appropriate drainage ways. In addition, appropriate drainage ways shall be maintained at all earthwork surface areas in order to not affect compaction.

Shallow Foundation Recommendations

Based on the provided/assumed structural loads and subsurface soil conditions encountered in our test boring locations, the proposed structure's load bearing walls may be supported on continuous spread footings. **Continuous footings bearing at least 18 inches below finished grade, within properly compacted structural fill or in-situ stiff clays, may be designed for a net allowable bearing capacity of 1,200 pounds per square foot (psf). Please note that the in-situ soils have a higher bearing capacity. However, the settlement tolerance was the deciding factor on the maximum allowable bearing pressure.** A minimum dimension of eighteen (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, foundation excavations should be observed, and concrete placed as quickly as possible to avoid exposure of the foundation bottoms 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

five (5) 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 five (5) feet of structural fill material in accordance with the recommendations presented herein, and after fill material has been in-place for a period of at least 45 days (as required based on the amount of fill placed), are expected to be less than one (1) inch. Installation of the drilled shafts and other utilities can occur during the 45 day hold period, but construction of the continuous footings and floor slab should not be performed until the 45 day hold period is completed. 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.

Auger Cast-in-Place Piles and Drilled Shafts Foundation Recommendations

Auger cast-in-place piles (herein referred as ACIP piles) and drilled shafts foundation systems were evaluated for the proposed structures. Analyses were made based our understanding of the subsurface conditions and provided design data with regard to ACIP piles/straight sided drilled shafts for support of the construction of the proposed structures. The ACIP piles and drilled shafts will generally derive their support through side resistance and some end bearing. **The estimated *Ultimate Single ACIP Pile/Drilled Shaft Capacity vs Depth curves* sheets and the estimated *Settlement vs Load curves* sheets are provided in the Appendix at the end of this report. The capacities presented in the aforementioned sheets are **ULTIMATE capacities, and a Factor of Safety = 2.0 in compression and 3.0 in tension MUST be applied to derive an allowable, single pile/shaft capacity assuming at least one (1) load test is performed for each deep foundation type, size and proposed tip elevation. If a pile load test is not feasible or economical for this project, a factor of safety of 3.0 should be applied for compression. The shaft capacities can be increased by 33% for transient loading conditions.** Capacities for pile types and/or lengths other than those provided in this report can be provided upon request.**

Please note that: 1. These are soil-pile/soil-shaft related capacities. The structural capacity/integrity of the piles/shafts to support design loads is beyond our scope of services and

must be verified by others. 2. Pile/shaft lengths are referenced from the existing ground surface at the time of field exploration. Additional pile/shaft length should be added depending on the design grade. 3. Tension capacity of auger cast piles and drilled shafts is based on the assumption that the skin friction is mobilized for full pile length depending on the type and length of reinforcement. This should be verified by others or through a tension load test performed by Premier.

The soil, as well as the rigidity of the pile/shaft, should resist the lateral loads on the pile/shaft. Once the locations, loads and other pertinent information are provided, Premier can assist in performing lateral load analyses based on methods ranging from chart solutions to the 'p-y' approach utilizing computer programs such as L-PILE.

Settlement and Group Effects

The estimated settlement of an individual ACIP pile/drilled shaft is shown on the attached *Auger Cast-in-Place Pile/Drilled Shaft Settlement vs. Load curves* sheets. Once a load test(s) is performed, Premier can evaluate the capacity and settlement for pile/shaft groups.

Furthermore, placement of more than two (2) feet of fill material can impart negative skin friction or drag loads to the piles causing an increase of settlement. Therefore, to reduce the fill induced negative skin friction, we recommend installing the piles/shafts during the fill hold period. Upon the completion of the fill hold period, the Structural Engineer should inspect the piles/shaft and adjust the pile/shaft cap to account with any settlement of the piles/shafts.

The piles/shafts shall be installed at a minimum center to center spacing of three (3) pile/shaft diameters or side dimension. For this spacing and with the pile/shaft cap in firm contact with the soil, a reduction of capacity due to group effects should not be required. If the pile/shaft cap will not be in firm contact with the soil, group effects could result in additional reduction of the pile/shaft capacities and should be evaluated accordingly once actual pile/shaft length and layout are known.

ACIP/Drilled Shafts Load Test

As previously mentioned, it is recommended that pile/shaft capacities be verified by a field load test. At least one (1) test pile/shaft shall be installed in the proposed foundation area and tested in compression to at least 200% of the design load as outlined by ASTM D 1143, Standard Test Method for Piles Under Static Axial Compression Load, and in tension to at least 300% of the design load. The load test(s) shall be performed under the guidance of Premier's Geotechnical Engineer so that the data may be interpreted, and the estimated pile/shaft capacity adjusted, if necessary, according to the load test results. The test pile(s)/shaft(s) and reaction piles/shafts should be allowed to set for a minimum of 14 days prior to loading.

Pile/Shaft Installation

The proposed structures can be founded on auger cast-in-place piles or drilled shafts. Load bearing properties of at least one of the ACIP or drilled shafts should be evaluated by

performing a load test in general accordance with the “Standard Method of Testing Piles under Axial Compressive Load”, (ASTM D1143) prior to constructing the remaining pile/shaft foundations. Procedures required for constructing the test pile/shaft should be observed in order to establish desirable procedures for constructing the remaining piles/shafts. The test pile/shaft concrete should be at least 14-days old at the start of the load test with a 7-day break of a test cylinder of at least 80% of the design strength. Accurate records of the ACIP pile/shaft installations shall be obtained during construction and in accordance with the observation requirements listed in this report. Installation of ACIP pile/drilled shafts shall not be undertaken within 8 diameters of pile/shaft elements that are less than 24-hours since concrete placement.

ACIP Piles Construction Considerations

Satisfactory performance of ACIP piles is often dependent upon the skill of the contractor installing them. A demonstration pile is recommended for the contractor to demonstrate that the operator and system have the procedures and skills that match the site conditions. ACIP piles are installed by rotating a continuous-flight hollow-stem auger into the subgrade and advancing to a predetermined depth. When the depth is reached, a high strength sand-cement grout is pumped, under controlled pressure, through the center of the shaft as the auger is slowly withdrawn. By maintaining pressure in the grout line and slowly extracting the auger no faster than an equivalent volume of grout is pumped, a continuous column of concrete is formed.

It should be noted that installation of ACIP piles in layered soil conditions consisting of soft clays and granular soils of varying relative densities often cause large grout overruns. For example, actual grout volumes on the order of 115 to 130 percent of the theoretical volume of the piles should be anticipated at the subject site. It is the piling contractor’s responsibility to properly estimate grout volumes and implement appropriate installation methods to ensure production of continuous grout shafts without undue soil disturbance.

A properly functioning pressure gage and pump stroke counter should be provided on the grout pump to assist in monitoring ACIP pile installations. The counter is used to determine the volume of grout pumped by counting the number of strokes of a displacement-type pump. The pump should be calibrated prior to its use and any time grout takes are questionable. The pressure gage is used to monitor the pressure of the grout to evaluate the rate at which the auger should be retracted and if the auger or hoses are plugged. The auger should be withdrawn with slow positive rotation at a slow steady pull and should not be pulled until the grout has been pumped several feet above the downhole tip. Hydraulic controls should be required on the crane supporting the auger so that the auger can be withdrawn in a slow, smooth, continuous motion.

If improper procedures are used during installation of ACIP piles, the installation can cause ground loss in the immediate vicinity of the pile due to overmining, with resulting local surface subsidence. In some soil conditions, the pressure of the grout can cause vertical movement or heave of adjacent soil and structures. The static load of the grout plus the added installation pressure may cause local “failure” of the soil, resulting in high grout-takes. Conversely, if not enough head is maintained, the soil could squeeze, resulting in necked piles.

Drilled Shafts Construction Considerations

Due to the relatively shallow groundwater level at the project site, the need for casing or drilling slurry to install the proposed shafts below a depth of about four (4) feet may be needed. It is the Contractor's responsibility to ensure the drilled shafts are properly installed to the plan tip elevation and shall determine if casing or drilling slurry will be required to do so prior to installation. Concrete placement should be by tremie methods. It may be required to utilize steel casing in order to prevent sloughing of soils and excessive water intrusion into the borehole. All aspects of drilled shaft construction, including quality control, should be conducted in accordance with the Federal Highway Administration (FHWA) Publication No. FHWA-IF-99-025 titled Drilled Shafts: Construction Procedures and Design Methods. Detailed inspection of shaft construction should be made to verify that the shafts are vertical and founded in the proper bearing stratum and to verify that all loose and soft materials have been removed prior to concrete placement.

Where water inflow or caving soils are encountered, excavation of shafts and placement of concrete within a very short time frame will frequently aid in proper shaft construction. It is recommended that concrete be readily available on-site prior to beginning any shaft excavation. Installation of drilled shafts below the groundwater level may require slurry techniques to prevent collapse of the borehole and concrete placement should be by tremie. It may be required to utilize steel casing in order to prevent sloughing of soils and excessive water intrusion into the borehole. The following items are fundamental to proper performance of shafts in accordance with design recommendation:

- Subsurface conditions are as anticipated from the borings;
- Shafts are constructed to the proper diameter;
- Proper penetration and plumbness are achieved;
- Reinforcing is properly placed and centered in the open shaft; and,
- Concrete is placed properly.

We recommend that Premier's Geotechnical Engineer or their qualified technician observe the installation of the shafts to verify that, among other things: 1) subsurface conditions are as anticipated from the boring, 2) the shafts are constructed to the proper diameter, penetration and plumbness, 3) reinforcing is properly placed and centered in the open shaft, and 4) proper concrete placement. These critical items are fundamental to proper performance of shafts in accordance with design recommendations.

Floor Slab

The floor slab can be grade supported on naturally occurring medium stiff 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 such 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-

lb/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.

If surficial fat clays are encountered while achieving compaction or passing a proof-roll, replacing this material with a low plasticity compacted soil or a dense positively drained graded crushed stone/concrete may be required. Alternatively, Class "C" flyash 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" flyash or lime product, Premier recommends the actual application percent be determined by conducting a laboratory Class "C" flyash 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

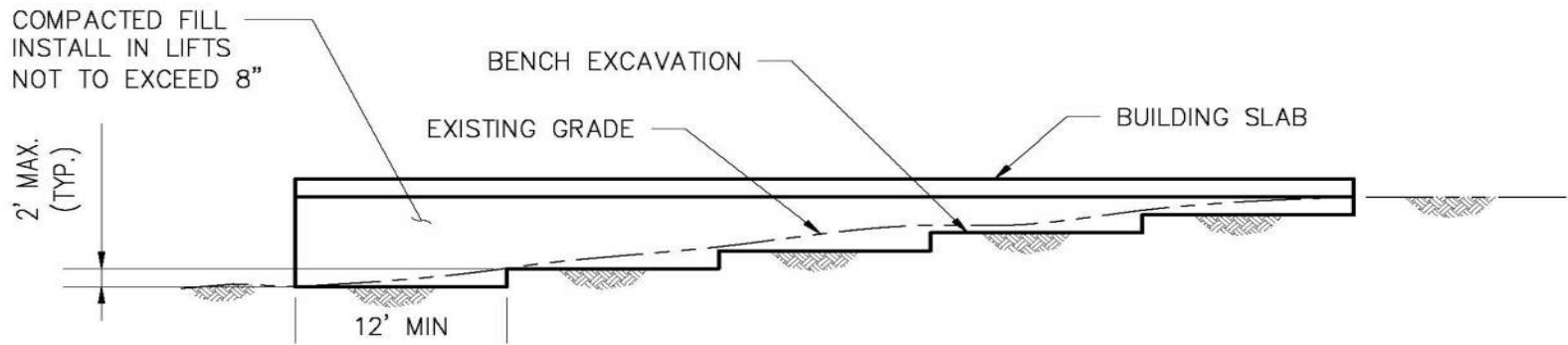
necessary for the proposed structure(s) to perform according to the proposed design based on the information generated and referenced during this evaluation, and Premier's experience in working with those conditions.

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 of 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.

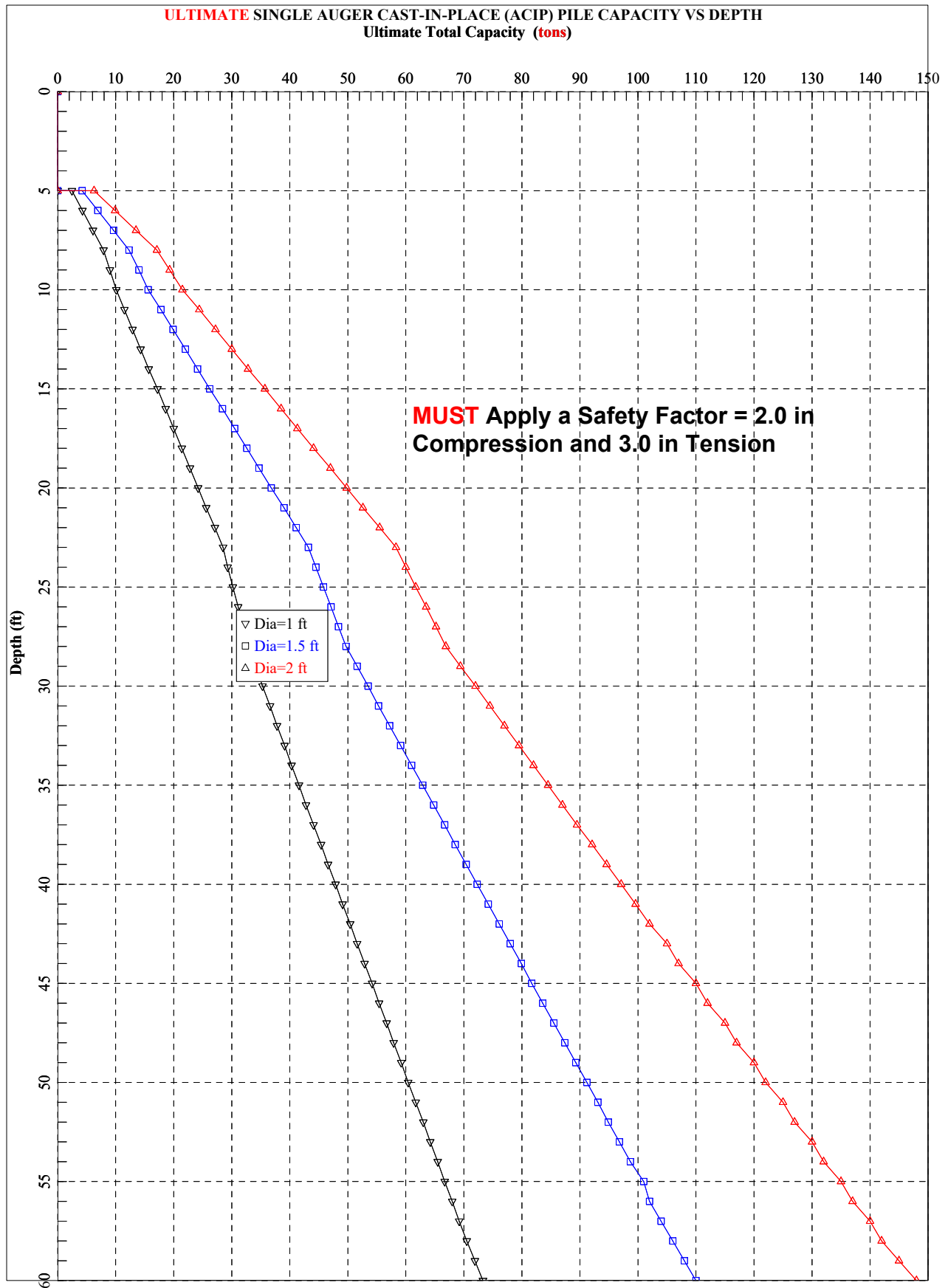
This report and the information/data provided have been prepared for the exclusive use of WTD Architecture and their design team for the specific application to the proposed The Newtron Group – New Campus project to be located in Baton Rouge, Louisiana. The information and data obtained and prepared (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.

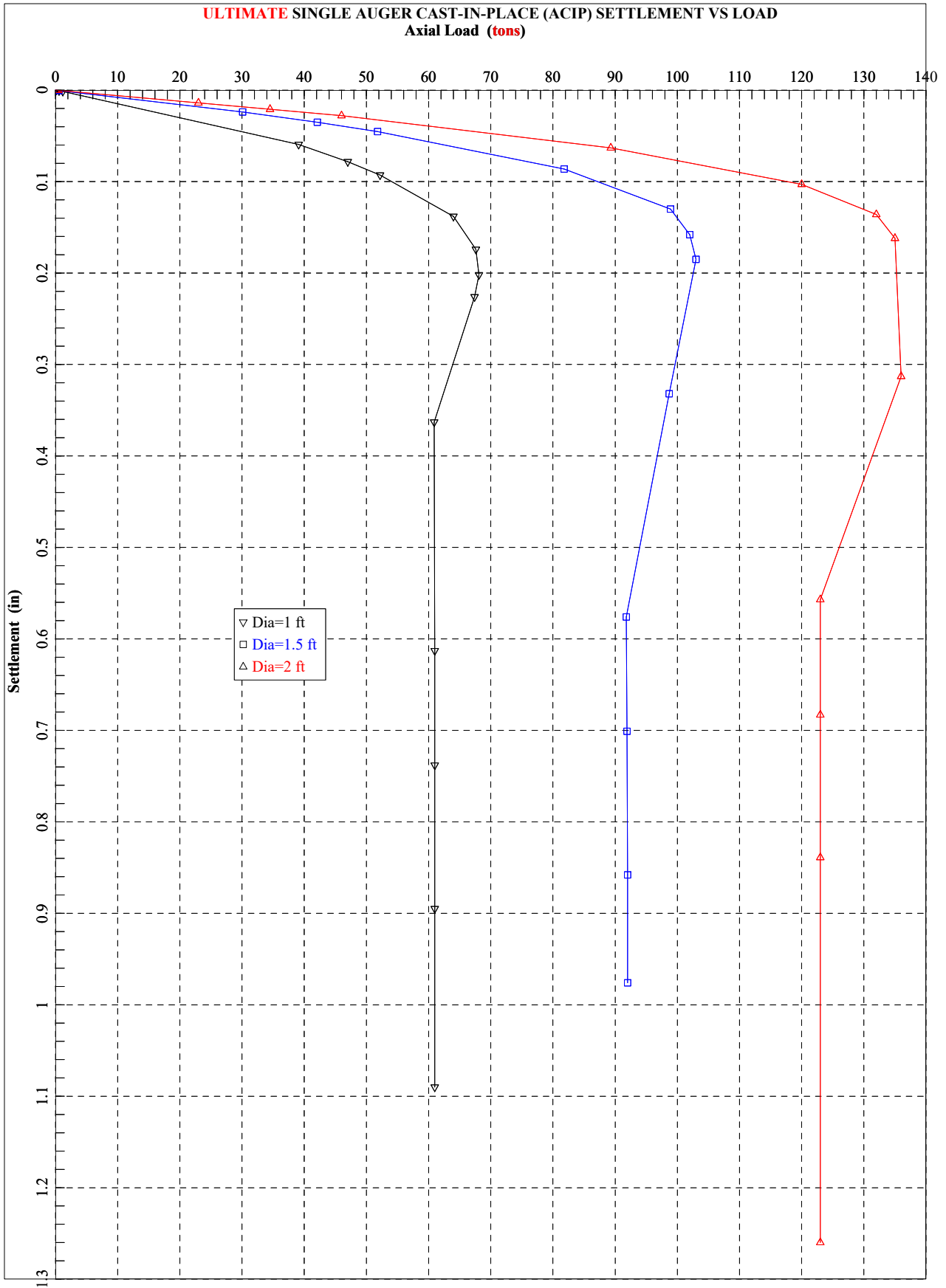


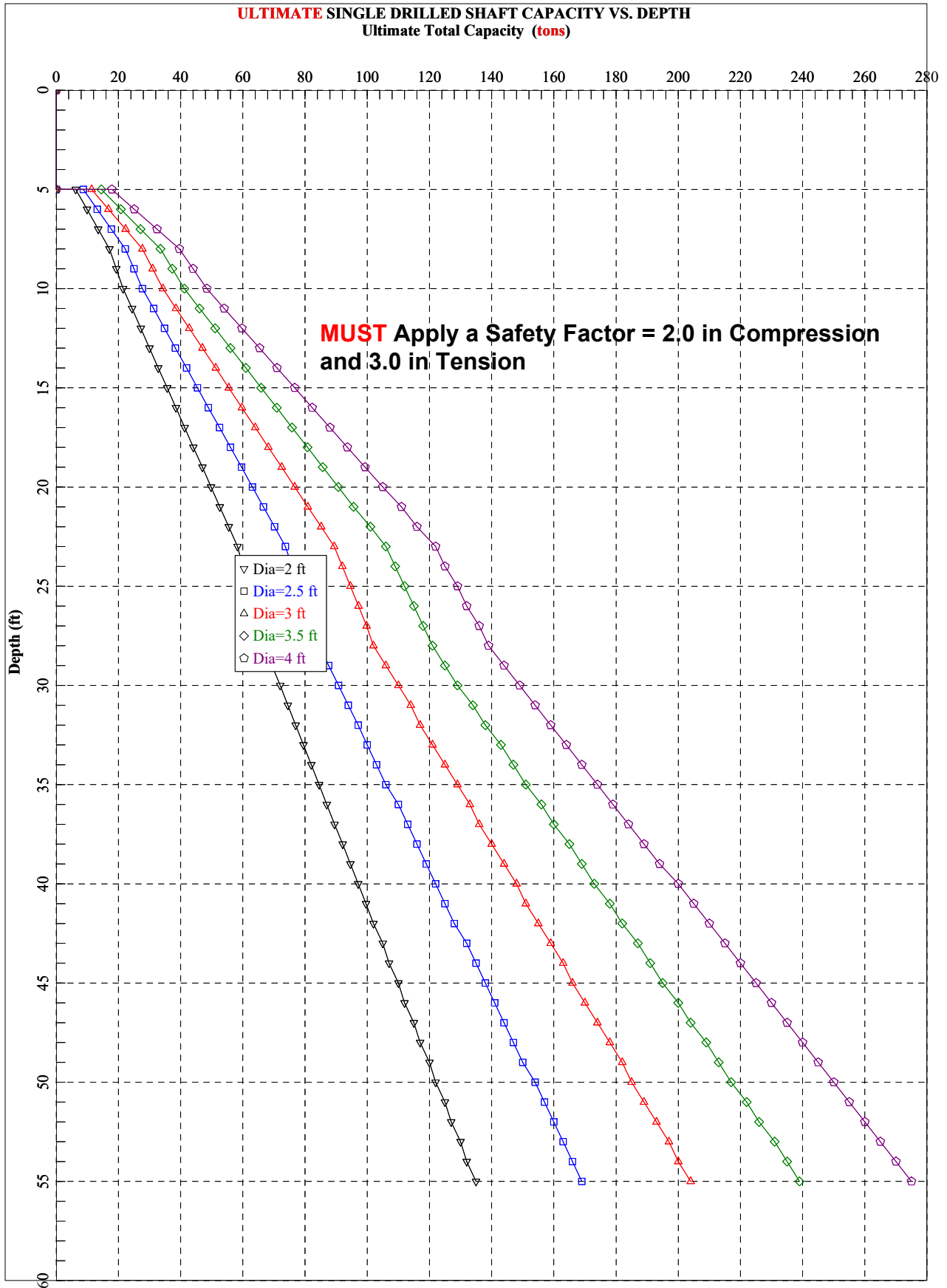
PROPOSED THE NEWTRON GROUP
 NEW CAMPUS
 BATON ROUGE, LA
 PREMIER FILE NO.: 21-0020

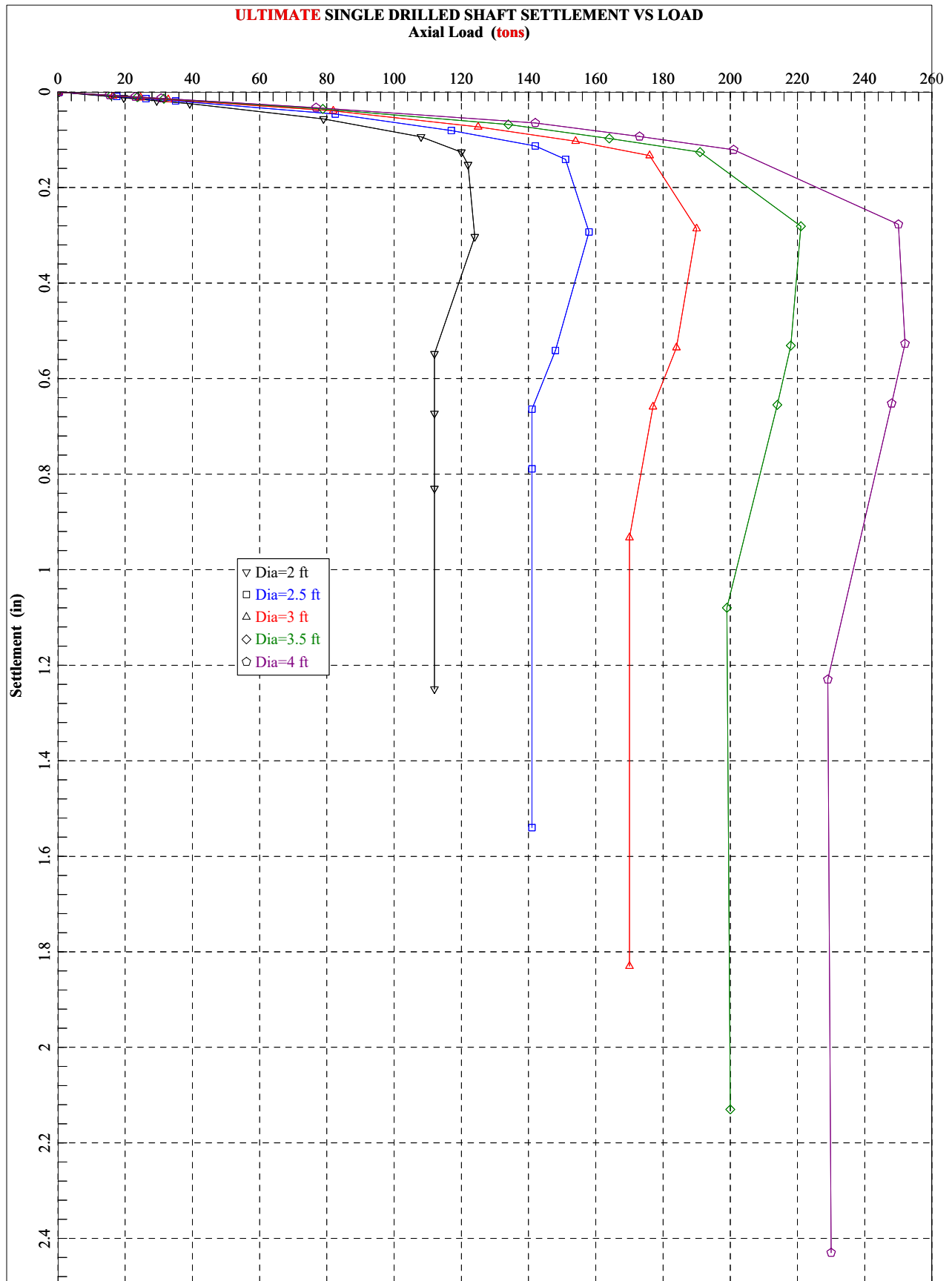


BENCHING FILL
 PLACEMENT











 APPROXIMATE TEST LOCATION



PROPOSED THE NEWTRON GROUP
 NEW CAMPUS
 BATON ROUGE, LA
 PREMIER FILE NO.: 21-0020



TEST LOCATION PLAN

KEY TO SYMBOLS

Symbol Description

Strata symbols



Poorly graded gravel



High plasticity
clay



Low plasticity
clay



Silty low plasticity
clay

Misc. Symbols



Water table during
drilling



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.

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°22'5.73"N 91° 1'45.39"W | | CLASSIFICATION | | | | | | SHEAR STRENGTH | | | | | | |
|---------------------|-------------|--------|---------|----------------|---|---|-------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--|--|--|--|--|--|
| | | | | | SURFACE EL.: EXISTING GRADE | | UNIT DRY WT. FCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | TONS PER SQ FT | | | | | | |
| STRATUM DESCRIPTION | | | | | | | STRATUM DEPTH, FT | | | | | | | | | | | | |
| 0 | | | | | | 6" GRAVEL | 0.5 | | | 25.5 | | | | | | | | | |
| | | | | | | Tan, Red and Light Gray FAT CLAY (CH) with silt pockets | | | | | | | | | | | | | |
| | | | | | | Stiff, Tan and Light Gray FAT CLAY (CH) with ferrous nodules and silt | | 93.3 | 27.7 | 55 | 24 | 31 | | | | | | | |
| | | | | | | Light Gray and Tan LEAN CLAY (CL) with ferrous nodules | 4.0 | | | 20.5 | | | | | | | | | |
| 5 | | | | | | Very Stiff, Tan and Light Gray LEAN CLAY (CL) with fat clay pockets | | 110.3 | 19.3 | 45 | 15 | 30 | | | | | | | |
| | | | | | | Tan and Light Gray FAT CLAY (CH) with trace silt | 8.0 | | | 20.9 | | | | | | | | | |
| | | | | | | Stiff, Light Gray and Tan FAT CLAY (CH) with silt seams | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | |
| | | | | | | Tan and Light Gray FAT CLAY (CH) | | | | 29.7 | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | | | | | |
| | | | | | | Light Gray and Tan FAT CLAY (CH) | | | | 33.3 | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | |
| | | | | | | Very Stiff, Light Gray and Tan FAT CLAY (CH) with silt | | | | 29.9 | 66 | 24 | 42 | | | | | | |
| 25 | | | | | | | | | | | | | | | | | | | |
| | | | | | | Tan and Gray FAT CLAY (CH) | | | | 33.4 | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | | | | | | | |

NOTES:

DRILLED DATE: 2/25/2021
 DRILLER: PREMIER GEOTECH
 LOGGER: W.W.
 TOTAL DEPTH (Ft): 65
 WATER LEVEL: 30'
 BACKFILL: CEMENT-BENTONITE GROUT

LOG OF BORING B-1
 NEWTRON GROUP NEW CAMPUS

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°22'5.73"N 91° 1'45.39"W | STRATUM DEPTH, FT | CLASSIFICATION | | | | | | SHEAR STRENGTH | | | | | | | | | | | | |
|---------------------|-------------|--------|---------|----------------|---|-------------------|------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--------------|-----------|------------|--------------|------------------|--|--|--|--|--|--|--|
| | | | | | SURFACE EL.: EXISTING GRADE | | UNIT DRY WT. FCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | □ Penetrometer | ■ Unconfined | ◇ Torvane | ● Triaxial | △ Field Vane | ▲ Miniature Vane | | | | | | | |
| STRATUM DESCRIPTION | | | | | | TONS PER SQ FT | | | | | | | | | | | | | | | | | | | |
| | | | | | | 0.5 | 1 | 1.5 | 2 | 2.5 | | | | | | | | | | | | | | | |
| | | | | | Light Gray and Tan FAT CLAY (CH) with silt | | | | | | | | | | | | | | | | | | | | |
| 40 | | | | | Stiff, Gray and Tan FAT CLAY (CH) | 84.8 | | | 39.2 | | | | | | | | | | | | | | | | |
| 45 | | | | | Light Gray and Tan FAT CLAY (CH) | | | | 28.7 | | | | | | | | | | | | | | | | |
| 50 | | | | | Gray and Tan FAT CLAY (CH) | | | | 37.5 | | | | | | | | | | | | | | | | |
| 55 | | | | | Stiff, Light Gray and Tan FAT CLAY (CH) with calcareous nodules | 101.5 | | | 23.0 | | | | | | | | | | | | | | | | |
| 60 | | | | | Tan and Light Gray FAT CLAY (CH) with calcareous nodules | | | | 35.2 | | | | | | | | | | | | | | | | |
| 65 | | | | | Boring Terminated at 65 Feet | 65.0 | | | | | | | | | | | | | | | | | | | |
| 70 | | | | | | | | | | | | | | | | | | | | | | | | | |

NOTES:

DRILLED DATE: 2/25/2021
DRILLER: PREMIER GEOTECH
LOGGER: W.W.
TOTAL DEPTH (Ft): 65
WATER LEVEL: 30'
BACKFILL: CEMENT-BENTONITE GROUT

**LOG OF BORING B-1
NEWTRON GROUP NEW CAMPUS**

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°22'7.08"N 91° 1'45.41"W SURFACE EL.: EXISTING GRADE | STRATUM DEPTH, FT | CLASSIFICATION | | | | | SHEAR STRENGTH | | | | | | | |
|-----------|-------------|--------|---------|----------------|--|-------------------|------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--|--|--|--|--|--|
| | | | | | | | UNIT DRY WT. PCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | TONS PER SQ FT | | | | | | |
| 0 | | | | | Tan and Gray LEAN CLAY (CL) with ferrous stains | | | 26.8 | | | | | | | | | | | |
| | | | | | Stiff, Tan and Light Gray LEAN CLAY (CL) with ferrous nodules | 95.4 | | 26.3 | 44 | 20 | 24 | | | | | | | | |
| | | | | | Tan and Light Gray LEAN CLAY (CL) | | | 24.7 | | | | | | | | | | | |
| 5 | | | | | Very Stiff, Tan and Light Gray LEAN CLAY (CL) with fat clay pockets | 104.3 | | 21.4 | 47 | 18 | 29 | | | | | | | | |
| | | | | | Tan FAT CLAY (CH) with silt and ferrous nodules | 8.0 | | 22.3 | | | | | | | | | | | |
| 10 | | | | | Tan and Gray FAT CLAY (CH) | | | 29.3 | | | | | | | | | | | |
| | | | | | Very Stiff, Light Gray and Tan Jointed FAT CLAY (CH) with trace silt | 97.1 | | 26.4 | 63 | 24 | 39 | | | | | | | | |
| 15 | | | | | Tan and Light Gray FAT CLAY (CH) | | | 30.7 | | | | | | | | | | | |
| 20 | | | | | Tan and Light Gray FAT CLAY (CH) with silt BECOMING Light Gray SILT with SAND (ML) with clay | | | 82.0 | 27.0 | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | | | | | | |
| 30 | | | | | Boring Terminated at 30 Feet | 30.0 | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | | | | | | | |

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 2/17/2021
 DRILLER: PREMIER GEOTECH
 LOGGER: W.W.
 TOTAL DEPTH (Ft): 30
 WATER LEVEL: NE
 BACKFILL: CEMENT-BENTONITE GROUT

LOG OF BORING B-2
 NEWTRON GROUP NEW CAMPUS

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°22'5.43"N 91° 1'44.31"W | CLASSIFICATION | | | | | | SHEAR STRENGTH | | | | | | | |
|-----------|-------------|--------|---------|----------------|--|------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--|--|--|--|--|--|--|
| | | | | | | UNIT DRY WT. PCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | TONS PER SQ FT | | | | | | | |
| 0 | | | | | SURFACE EL.: EXISTING GRADE | | | | | | | | | | | | | | |
| | | | | | STRATUM DESCRIPTION | | | | | | | | | | | | | | |
| | | | | | Stiff, Gray SILT (ML) with clay, wood and ferrous nodules BECOMING Gray, Light Gray and Brown FAT CLAY (CH) with trace organics and silt | 105.0 | | 20.8 | 52 | 21 | 31 | | | | | | | | |
| | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous nodules | | | 15.7 | | | | | | | | | | | |
| | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous nodules | | | 24.5 | | | | | | | | | | | |
| 5 | | | | | Very Stiff, Tan and Light Gray LEAN CLAY (CL) with ferrous nodules/stains | 107.7 | | 20.4 | 38 | 17 | 21 | | | | | | | | |
| | | | | | Tan and Gray FAT CLAY (CH) with trace silt and ferrous nodules | | | 22.4 | | | | | | | | | | | |
| 10 | | | | | Stiff, Tan and Light Gray FAT CLAY (CH) | 99.5 | | 24.5 | 73 | 20 | 53 | | | | | | | | |
| | | | | | Light Gray and Tan FAT CLAY (CH) with trace silt | | | 32.2 | | | | | | | | | | | |
| 20 | | | | | Medium, Light Gray and Tan FAT CLAY (CH) with ferrous stains | 101.1 | | 30.9 | 75 | 24 | 51 | | | | | | | | |
| 25 | | | | | Light Gray and Tan FAT CLAY (CH) | | | 31.6 | | | | | | | | | | | |
| 30 | | | | | Boring Terminated at 30 Feet | 30.0 | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | | | | | | | |

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 2/18/2021
 DRILLER: PREMIER GEOTECH
 LOGGER: W.W.
 TOTAL DEPTH (Ft): 30
 WATER LEVEL: NE
 BACKFILL: CEMENT-BENTONITE GROUT

LOG OF BORING B-3
 NEWTRON GROUP NEW CAMPUS

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°22'4.81"N 91° 1'46.86"W | STRATUM DEPTH, FT | CLASSIFICATION | | | | | SHEAR STRENGTH | | | | | | | | |
|-----------|-------------|--------|---------|----------------|---|-------------------|------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--|--|--|--|--|--|--|
| | | | | | | | UNIT DRY WT. PCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | TONS PER SQ FT | | | | | | | |
| 0 | | | | | SURFACE EL.: EXISTING GRADE | | | | | | | | | | | | | | | |
| | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous nodules | | | 18.5 | | | | | | | | | | | | |
| | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous nodules | | | 24.0 | | | | | | | | | | | | |
| 5 | | | | | Very Stiff, Tan and Light Gray FAT CLAY (CH) with silt and ferrous nodules | 4.0 | 106.2 | 21.7 | 56 | 18 | 38 | | | | | | | | | |
| | | | | | Tan and Light Gray FAT CLAY (CH) with trace silt | | | 27.9 | | | | | | | | | | | | |
| | | | | | Stiff, Tan and Light Gray FAT CLAY (CH) | | 94.1 | 30.8 | 74 | 23 | 51 | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | |
| | | | | | Tan and Light Gray FAT CLAY (CH) | | | 29.3 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | | | | | | |
| | | | | | Tan and Light Gray FAT CLAY (CH) | | | 30.0 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | | |
| | | | | | Tan and Light Gray FAT CLAY (CH) | | | 30.5 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | | | | | | | |
| | | | | | Stiff, Tan, Brown and Light Gray FAT CLAY (CH) with ferrous nodules/stains | | 96.7 | 26.1 | 67 | 23 | 44 | | | | | | | | | |
| 30 | | | | | Boring Terminated at 30 Feet | 30.0 | | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | | | | | | | | |

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 2/18/2021
 DRILLER: PREMIER GEOTECH
 LOGGER: W.W.
 TOTAL DEPTH (Ft): 30
 WATER LEVEL: NE
 BACKFILL: CEMENT-BENTONITE GROUT

LOG OF BORING B-4
 NEWTRON GROUP NEW CAMPUS

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°22'3.84"N 91° 1'45.34"W | CLASSIFICATION | | | | | | SHEAR STRENGTH | | | | | | | |
|-----------|-------------|--------|---------|----------------|--|------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--|--|--|--|--|--|--|
| | | | | | | UNIT DRY WT. PCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | TONS PER SQ FT | | | | | | | |
| 0 | | | | | SURFACE EL.: EXISTING GRADE | | | | | | | | | | | | | | |
| | | | | | STRATUM DESCRIPTION | | | | | | | | | | | | | | |
| | | | | | Brown LEAN CLAY (CL) with fine sand and roots | | | 27.5 | | | | | | | | | | | |
| | | | | | Stiff, Gray SILTY CLAY (CL-ML) with ferrous nodules BECOMING Tan, Light Gray and Brown FAT CLAY (CH) with ferrous nodules and silt | 2.0 | 99.5 | 24.8 | 62 | 22 | 40 | | | | | | | | |
| | | | | | Gray and Tan LEAN CLAY (CL) | 4.0 | | 28.2 | | | | | | | | | | | |
| 5 | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous nodules | | | 24.5 | | | | | | | | | | | |
| | | | | | Tan and Light Gray LEAN CLAY (CL) | | | 24.2 | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | |
| | | | | | Tan and Light Gray FAT CLAY (CH) with silt | 13.0 | | 26.6 | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | | | | | |
| | | | | | Stiff, Tan FAT CLAY (CH) with silt pockets/seams | | 96.2 | 26.6 | 65 | 18 | 47 | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | |
| | | | | | Stiff, Light Gray and Tan FAT CLAY (CH) with silt | | 90.3 | 33.6 | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | | | | | | |
| | | | | | Light Gray and Tan FAT CLAY (CH) with silt | | | 20.7 | | | | | | | | | | | |
| 30 | | | | | Boring Terminated at 30 Feet | 30.0 | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | | | | | | | |

NOTES:

DRILLED DATE: 2/18/2021
DRILLER: PREMIER GEOTECH
LOGGER: W.W.
TOTAL DEPTH (Ft): 30
WATER LEVEL: 4'
BACKFILL: CEMENT-BENTONITE GROUT

LOG OF BORING B-5
NEWTRON GROUP NEW CAMPUS

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°21'58.41"N 91° 1'51.77"W SURFACE EL.: EXISTING GRADE | STRATUM DEPTH, FT | CLASSIFICATION | | | | | | SHEAR STRENGTH | | | | | |
|-----------|-------------|--------|---------|----------------|---|-------------------|------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--|--|--|--|--|
| | | | | | | | UNIT DRY WT. PCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | TONS PER SQ FT | | | | | |
| 0 | | | | | Tan and Gray FAT CLAY (CH) with silt and ferrous nodules | | | 31.3 | 54 | 27 | 27 | | | | | | | |
| | | | | | Stiff, Tan and Light Gray LEAN CLAY (CL) with ferrous nodules | 2.0 | 103.4 | 21.6 | | | | | | | | | | |
| | | | | | Very Stiff, Tan and Gray FAT CLAY(CH) with silt | 4.0 | 103.6 | 23.5 | 61 | 19 | 42 | | | | | | | |
| 5 | | | | | Tan and Gray FAT CLAY (CH) with ferrous nodules | | | 23.2 | 55 | 18 | 37 | | | | | | | |
| | | | | | Stiff, Tan and Light Gray FAT CLAY (CH) | | 95.0 | 28.5 | 68 | 22 | 46 | | | | | | | |
| | | | | | Light Gray and Tan FAT CLAY (CH) | | | 29.8 | | | | | | | | | | |
| 10 | | | | | Light Gray and Tan FAT CLAY (CH) with silt pockets | | | 27.8 | | | | | | | | | | |
| | | | | | Light Gray and Tan FAT CLAY (CH) with silt pockets | | | 28.6 | | | | | | | | | | |
| 15 | | | | | Gray and Tan LEAN CLAY (CL) | 28.0 | | 30.5 | 35 | 24 | 11 | | | | | | | |
| 20 | | | | | Boring Terminated at 30 Feet | 30.0 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | | | | | | |

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 2/19/2021
 DRILLER: PREMIER GEOTECH
 LOGGER: W.W.
 TOTAL DEPTH (Ft): 30
 WATER LEVEL: NE
 BACKFILL: CEMENT-BENTONITE GROUT

LOG OF BORING B-6
 NEWTRON GROUP NEW CAMPUS

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°21'57.27"N 91° 1'49.54"W | STRATUM DEPTH, FT | CLASSIFICATION | | | | | | SHEAR STRENGTH | | | | | |
|---------------------|-------------|--------|---------|----------------|--|-------------------|------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--|--|--|--|--|
| | | | | | SURFACE EL.: EXISTING GRADE | | UNIT DRY WT. PCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | TONS PER SQ FT | | | | | |
| STRATUM DESCRIPTION | | | | | | | | | | | | | | | | | | |
| 0 | | | | | Tan FAT CLAY (CH) with silt and ferrous nodules/stains | | | | 26.7 | 53 | 24 | 29 | | | | | | |
| | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous nodules | 2.0 | | | 24.6 | | | | | | | | | |
| | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous nodules | | | | 20.6 | 39 | 21 | 18 | | | | | | |
| 5 | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous nodules | | | | 23.6 | | | | | | | | | |
| | | | | | Tan and Light Gray FAT CLAY (CH) | 8.0 | | | 25.1 | 61 | 20 | 41 | | | | | | |
| | | | | | Light Gray and Tan FAT CLAY (CH) with ferrous stains | | | | 27.9 | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| 15 | | | | | Boring Terminated at 15 Feet | 15.0 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | | | | | | |

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 2/19/2021
 DRILLER: PREMIER GEOTECH
 LOGGER: W.W.
 TOTAL DEPTH (Ft): 15
 WATER LEVEL: NE
 BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING D-1
 NEWTRON GROUP NEW CAMPUS

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°21'59.49"N 91° 1'48.81"W | STRATUM DEPTH, FT | CLASSIFICATION | | | | | SHEAR STRENGTH | | | | | | | |
|---------------------|-------------|--------|---------|----------------|--|-------------------|------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--|--|--|--|--|--|
| | | | | | SURFACE EL.: EXISTING GRADE | | UNIT DRY WT. FCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | TONS PER SQ FT | | | | | | |
| STRATUM DESCRIPTION | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | Tan FAT CLAY (CH) with roots and ferrous nodules | | | | 27.7 | | | | | | | | | | |
| | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous nodules | 2.0 | | | 25.3 | 46 | 24 | 22 | | | | | | | |
| | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous nodules and fat clay pockets | | | | 23.5 | | | | | | | | | | |
| 5 | | | | | Tan and Light Gray FAT CLAY (CH) with silt | | | | 25.8 | 61 | 19 | 42 | | | | | | | |
| | | | | | Tan FAT CLAY (CH) with silt seams | 6.0 | | | 30.1 | | | | | | | | | | |
| | | | | | Light Gray and Tan FAT CLAY (CH) with silt and ferrous stains | | | | 28.4 | 57 | 22 | 35 | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| 15 | | | | | Boring Terminated at 15 Feet | 15.0 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | | | | | | | |

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 2/19/2021
 DRILLER: PREMIER GEOTECH
 LOGGER: W.W.
 TOTAL DEPTH (Ft): 15
 WATER LEVEL: NE
 BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING D-2
 NEWTRON GROUP NEW CAMPUS

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°22'6.55"N 91° 1'46.69"W SURFACE EL.: EXISTING GRADE | STRATUM DEPTH, FT | CLASSIFICATION | | | | | | SHEAR STRENGTH | | | | | | |
|-----------|-------------|--------|---------|----------------|--|-------------------|------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--|--|--|--|--|--|
| | | | | | | | UNIT DRY WT. FCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | TONS PER SQ FT | | | | | | |
| 0 | | | | | Tan, Brown and Light Gray LEAN CLAY (CL) with ferrous nodules | | | | 18.7 | 33 | 23 | 10 | | | | | | | |
| 2 | | | | | Tan LEAN CLAY (CL) with ferrous nodules/stains | | | | 26.8 | | | | | | | | | | |
| 4 | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous stains and fat clay pockets | | | | 22.5 | | | | | | | | | | |
| 6 | | | | | Boring Terminated at 6 Feet | 6.0 | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | | |

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 2/19/2021
 DRILLER: PREMIER GEOTECH
 LOGGER: W.W.
 TOTAL DEPTH (Ft): 6
 WATER LEVEL: NE
 BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-1
 NEWTRON GROUP NEW CAMPUS

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°22'2.93"N 91° 1'47.09"W SURFACE EL.: EXISTING GRADE | STRATUM DEPTH, FT | CLASSIFICATION | | | | | SHEAR STRENGTH | | | | | | | | |
|-----------|-------------|--------|---------|----------------|--|-------------------|------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--|--|--|--|--|--|--|
| | | | | | | | UNIT DRY WT. PCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | TONS PER SQ FT | | | | | | | |
| 0 | | | | | Tan, Brown and Light Gray LEAN CLAY (CL) with ferrous nodules | | | 23.4 | | | | | | | | | | | | |
| 2 | | | | | Medium, Tan LEAN CLAY (CL) with ferrous nodules | 93.4 | | 26.5 | 49 | 23 | 26 | | | | | | | | | |
| 4 | | | | | Tan LEAN CLAY (CL) with ferrous nodules | | | 27.7 | | | | | | | | | | | | |
| 6 | | | | | Boring Terminated at 6 Feet | 6.0 | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | | | |

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 2/19/2021
 DRILLER: PREMIER GEOTECH
 LOGGER: W.W.
 TOTAL DEPTH (Ft): 6
 WATER LEVEL: NE
 BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-2
 NEWTRON GROUP NEW CAMPUS

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°22'3.62"N 91° 1'48.26"W | STRATUM DEPTH, FT | CLASSIFICATION | | | | | | SHEAR STRENGTH | | | | | |
|---------------------|-------------|--------|---------|----------------|---|-------------------|------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--|--|--|--|--|
| | | | | | SURFACE EL.: EXISTING GRADE | | UNIT DRY WT. PCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | TONS PER SQ FT | | | | | |
| STRATUM DESCRIPTION | | | | | | | | | | | | | | | | | | |
| 0 | | | | | Tan and Light Gray SILTY CLAY (CL-ML) with roots | | | | 18.2 | 28 | 21 | 7 | | | | | | |
| 2 | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous nodules and silt lenses | 2.0 | | | 25.8 | | | | | | | | | |
| 4 | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous stains | | | | 23.3 | | | | | | | | | |
| 6 | | | | | Boring Terminated at 6 Feet | 6.0 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | |

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 2/19/2021
 DRILLER: PREMIER GEOTECH
 LOGGER: W.W.
 TOTAL DEPTH (Ft): 6
 WATER LEVEL: NE
 BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-3
 NEWTRON GROUP NEW CAMPUS

| DEPTH, FT | WATER LEVEL | SYMBOL | SAMPLES | BLOWS PER FOOT | LOCATION: BATON ROUGE, LOUISIANA COORDINATES: 30°22'1.49"N 91° 1'49.32"W SURFACE EL.: EXISTING GRADE | STRATUM DEPTH, FT | CLASSIFICATION | | | | | SHEAR STRENGTH | | | | | | | | |
|-----------|-------------|--------|---------|----------------|--|-------------------|------------------|-------------------------|------------------|--------------|---------------|-----------------------|----------------|--|--|--|--|--|--|--|
| | | | | | | | UNIT DRY WT. PCF | PASSING NO 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI) | TONS PER SQ FT | | | | | | | |
| 0 | | | | | Tan, Brown and Light Gray LEAN CLAY (CL) with ferrous nodules/stains | | | 20.1 | | | | | | | | | | | | |
| 2 | | | | | Medium, Tan and Gray LEAN CLAY (CL) with ferrous nodules | 92.8 | | 29.4 | 42 | 23 | 19 | | | | | | | | | |
| 4 | | | | | Tan and Light Gray LEAN CLAY (CL) with ferrous nodules/stains | | | 27.9 | | | | | | | | | | | | |
| 6 | | | | | Boring Terminated at 6 Feet | 6.0 | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | | | |

NOTES:
GROUNDWATER NOT ENCOUNTERED DURING DRILLING OPERATIONS

DRILLED DATE: 2/19/2021
 DRILLER: PREMIER GEOTECH
 LOGGER: W.W.
 TOTAL DEPTH (Ft): 6
 WATER LEVEL: NE
 BACKFILL: NATIVE SOIL CUTTINGS

LOG OF BORING P-4
 NEWTRON GROUP NEW CAMPUS